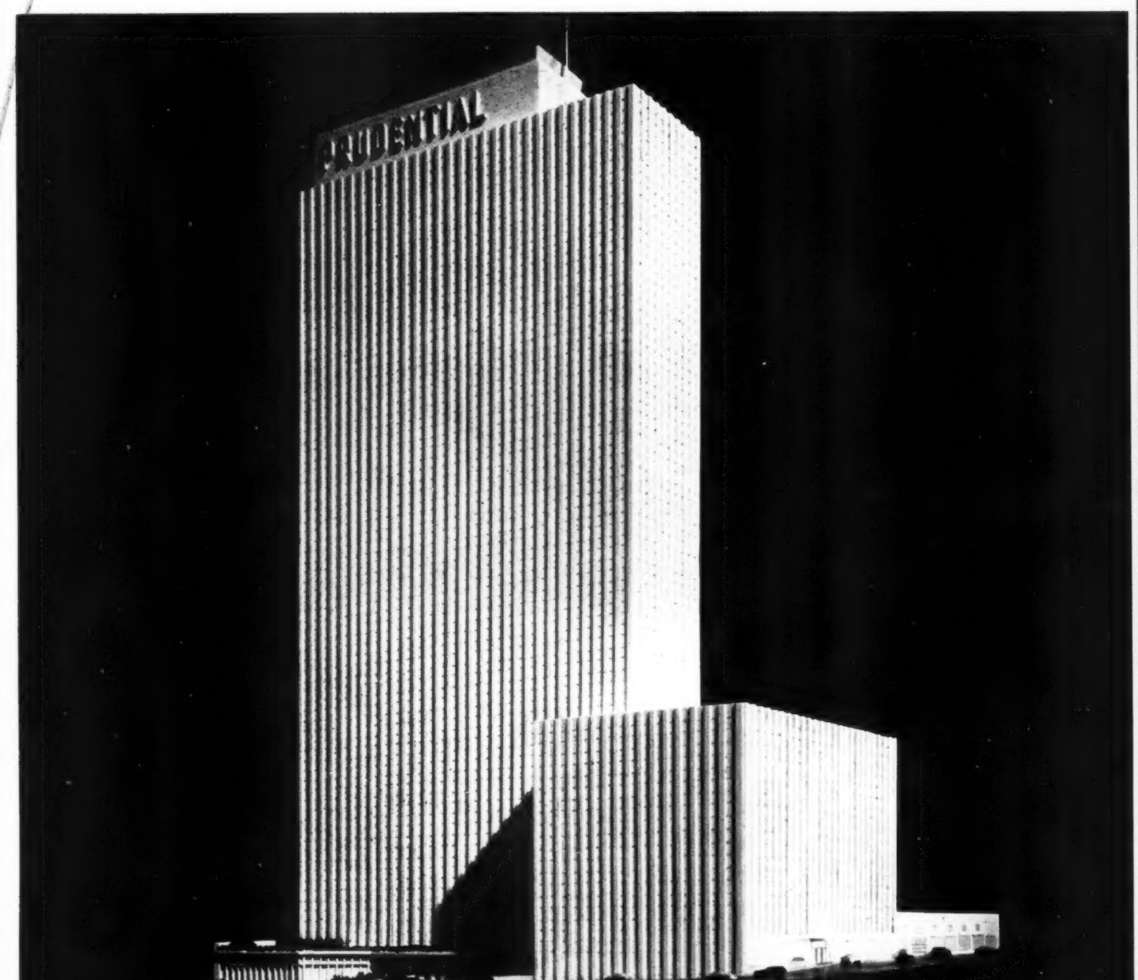
# Midwest Engineer

SERVING THE ENGINEERING PROFESSION

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OPERATING EXPERIENCES
WITH GAS TURBINES—PAGE THREE

WSE MEETINGS—PAGE TWO


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# Midwest Engineer

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*Serving the Engineering Profession*



APRIL, 1953 — Vol. 5, No. 11

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**Cover Story**

The graceful building on our cover, the new Prudential Building, will soon overlook the Society's Headquarters from a short distance to the east.

The $40,000,000 structure, on which work has already begun, will tower 41 stories over the Illinois Central yards between Michigan Avenue and the lake, and just north of Grant Park. When completed, the building will represent the first new office space in Chicago in 20 years. It will be the fifth largest office building in the United States.

## this month at WSE

COMING EVENTS OF INTEREST TO ALL MEMBERS

### May 4, No Meeting Scheduled

### May 6, Noon Luncheon Meeting

Speaker: W. W. Bauer, M.D., Director of the Bureau of Health Education of the American Medical Association, and Editor of *Today's Health.*

Subject: "Miracle Drugs."

Dr. Bauer will discuss the new drugs on the market, and tell something of their effects in various diseases.

### May 11, General Meeting

Speaker: Richard J. Schwarz, practising patent attorney and a member of the firm of Hill, Sherman, Maroni, Gross and Simpson, Patent and Trade-mark Lawyers.

Subject: "Patents and the Engineer."

Mr. Schwarz will include a historical sketch of patent practises of today and yesterday, and discuss some of the problems which confront the individual and companies in this field. He will also tell where and how the engineer fits into the subject of patents. Following his talk Mr. Schwarz will answer the questions which may be asked regarding patents and trademarks.

### May 13, Noon Luncheon Meeting

Speaker: To be announced.

Subject: To be announced.

### May 18, Mechanical Section

Speaker: K. A. Landis, Manager of Heavy Press Project, the E. W. Bliss Company, Canton, Ohio.

Subject: "The Heavy Forging Press Program."

This talk will pay especial attention to the 25,000 and 35,000 ton forging presses being constructed for the United States Air Force to speed the production of such stress parts as wing spars and engine mounts. The talk will cover design and construction procedures, and the transportation problems involved in carrying the huge metal masses from the factory to their destination at Newark, Ohio. In the talk a comparison will be made between the new presses and some existing heavy presses.

***Member, Save These Dates***

**May 16, Airport Excursion**

**May 25, Annual Spring Dinner**

**Aug. 15, Golf Tournament**

# Operating Experiences with Gas Turbines

By Paul R. Sidler

Basic gas turbine cycle diagrams have been shown to engineering audiences for many years now and it may thus be assumed that most of you are familiar with them.

**Gas Turbine Units in Operation.**

Table I gives basic data on the thirteen gas turbine units in operation at this time, arranged in the order of their setting to work. Besides rating, fuel used, overall thermal efficiency referred to generator terminals (or including the driven machine—item 11) and based on the net heat content of the fuel, it shows particularly the total number of operating hours and kilowatt-hours generated (or miles operated, items 2 and 10) brought up to date, as nearly as possible, to December 21, 1952.

**Difficulties Encountered and Remedied.**

Various troubles developed particularly in the first few units that went into operation; some could be remedied very easily, others required extensive research before a practical solution could be devised and a few problems are not fully solved as yet.

A large percentage of the difficulties encountered should be classified under the general heading of "growing pains." Once the causes are clearly established and proper remedies adopted such troubles will never again be repeated.

To this group belong damaged refractory liners in the combustion chamber (item 2), eliminated by the adoption of all metal liners, also soot fires in recuperators (items 2 and 3), solved by the installation of soot blowers as standard accessory. Soot deposits cannot always and entirely be avoided even with elaborate control equipment, particularly in plants which are started frequently.

Corrosion in intercoolers and resultant hard deposits on axial compressor blading (items 3 and 8) have been eliminated by design changes in the intercoolers. The primary cause—exhaust gas entering the air ducts—may be largely avoided by careful layout of the plant, attention to prevailing wind direction, etc. Local conditions may dictate the installation of filters at the air inlet ducts.

The breakage of axial compressor blades (items 3 and 8) due to self-

*(Continued on Page 4)*

Mr. Sidler, President, Brown Boveri Corporation, New York, gave this talk before the Western Society of Engineers on March 9, 1953, at the Society's Headquarters in Chicago.

Born in Zurich, Switzerland, Mr. Sidler has been a citizen of the United States since 1945. He is a licensed professional engineer, state of New York.

Table I

GAS TURBINE UNITS IN OPERATION

| Item | Installation | Capacity KW | Fuel | Efficiency (Gen. Term. %) | Start of Operation | Operating Hours | KWH Produced (in 1000 KWH) |
|---|---|---|---|---|---|---|---|
| 1. | Neuchatel, Switzerland | 4000 | oil | 17.3 | 1940 | 1700 | 3100 |
| 2. | Swiss Federal Railways Loc. | 1600 | oil | 18.0 | 1941 | 8000 | 350000 * |
| 3. | Beznau, Switzerland | 13000 | oil | 30.5 | 1948 | 8500 | 80000 |
| 4. | Chimbote, Peru | 4000 | oil | 19.5 | 1949 | 4500 | 1950 |
| 5. | Alexandria, Egypt | 1200 | oil | 22.9 | 1949 | 4500 | 3950 |
| 6/7. | Pertigalete, Venezuela | 1650 | oil | 25.0 | 1949 | I-13200 | 15500 |
| | | | | | | II-12500 | 14100 |
| 8. | Lima, Peru | 10/12000 | oil | 28.0 | 1949 | 11600 | 86000 |
| 9. | Beznau, Switzerland | 27000 | oil | 34.5 | 1949 | 5600 | 105000 |
| 10. | British Railways, Loc. | 1840 | oil | 18.0 | 1950 | 3700 | 120000 * |
| 11. | Baracaldo, Spain | 2000 | Bl. F. gas | 25.0 | 1951 | 4300 | 7300 ** |
| 12. | Dudelange, Luxembourg | 5400 | Bl. F. gas | 21.5 | 1951 | 9600 | 48000 |
| 13. | Filaret, Roumania | 10000 | Nat. | 23.5 | 1951 | 2400 | 15000 |
| | | | | | Total | 90100 hours | |

Status as of December 31, 1952

*) Miles travelled in regular train service

**) Furnishes compressed air, 23000 cfm 25 psig.

*(Continued from Page 3)*

induced vibrations is definitely an experience "of the past" after the phenomenon has been carefully analyzed. Damping wires, as were used in steam turbines for many years with full success, make such vibrations impossible.

Cracks in turbine rotors and turbine rotors and turbine blades (item 3) need not be feared again once their cause was clearly recognized and eliminated by design changes.

This leaves as a separate group the problems connected with ash in heavy fuel oils and it must be admitted immediately that not all these questions can be fully and finally answered at this time.

As matters stand now, the amount and composition of ash in a given heavy fuel oil determines whether this oil is suitable as gas turbine fuel at all or what operating cycle is permissible—allowing time out to remove turbine blade deposits at regular intervals.

Detailed records kept in most of these installations, supplemented by extensive laboratory tests, show that with certain ash compositions the greater part of the blade deposits is soluble in water and can therefore be removed periodically by working the built-in washing devices. In these cases the interruption of regular service is rather insignificant, f.i. 6-8 hours after every 500-600 hours. On the other hand a majority of ash components may form deposits which cannot be dissolved by water and would have to be ground or chipped out. Since this involves opening the gas turbine, coupled with very tedious and difficult cleaning operation, the practical conclusion must be that such oil cannot be used as gas turbine fuel today. Parts coming into direct contact with melted ash, particularly certain sections of combustion chamber liners, will show some wear and may have to be replaced after operating periods of 2-3,000 hours (specific figures will be given later).

The experience with all the sets burning heavy fuel oils has shown that reliable operation over extended periods—perhaps with brief interruptions for cleaning at regular intervals—can be achieved where gas inlet temperatures are kept around 1,200° F. i.e. below the fusion temperature of the most important ash components. Research work on a broad scale has been going on for several years—and continues today—with the aim of pushing the temperature limits upward without at the same time jeopardizing operating reliability.

This research covers the broad field of ash removal or neutralization, treatment by chemical additions, protective coatings, etc. Many interesting observations were made but the testing program is not complete and general conclusions are therefore not as yet possible. These problems are very complex and testing therefore takes much effort and time. Just to illustrate this point: It has been quite customary for some time to blame most troubles on the Vanadium content of the ash. There are, however, strong indications that the presence of Sodium (even in the form of seawater) greatly increases the aggressiveness of Vanadium salts or their tendency to form deposits.

**Maintenance**

The total operating time of the 13 sets in table I is 90,100 hours which represents an aggregate operation of ten years and four months; it is reasonable to feel that this is a sufficient length of time to have proven the basic design concepts of these machines. It is also long enough to draw conclusions regarding the operating reliability and the question of maintenance. Incidentally this total of operating hours is greater than that of all other gas turbine makes in the world put together.

As a summary of this experience it might be said that after correcting the initial troubles described in previous paragraphs there have been no further difficulties with any of these sets and no signs of developing trouble during the periodical inspections. All the shut-down periods of these units were scheduled.

Take for instance the two 1,650 KW sets at Pertigalete, Venezuela listed as items 6/7 in table I and shown in Figure 1. These units have by now completed 13-14,000 hours of operation each, using as fuel a mixture of Venezuelan Bunker C oil and Diesel oil in a ratio of 60/40% or 50/50%. This mixture was decided upon since Bunker C oil alone would exceed the limits of ash content which are still considered necessary and safe today. These sets are alternating in continuous service for periods of one month each and at the end of this monthly operation the turbine and recuperators are washed down to remove deposits from the oil ash.

It has been mentioned previously that liquid ash will attack certain sections of the inner liner of the combustion chamber with which it comes in

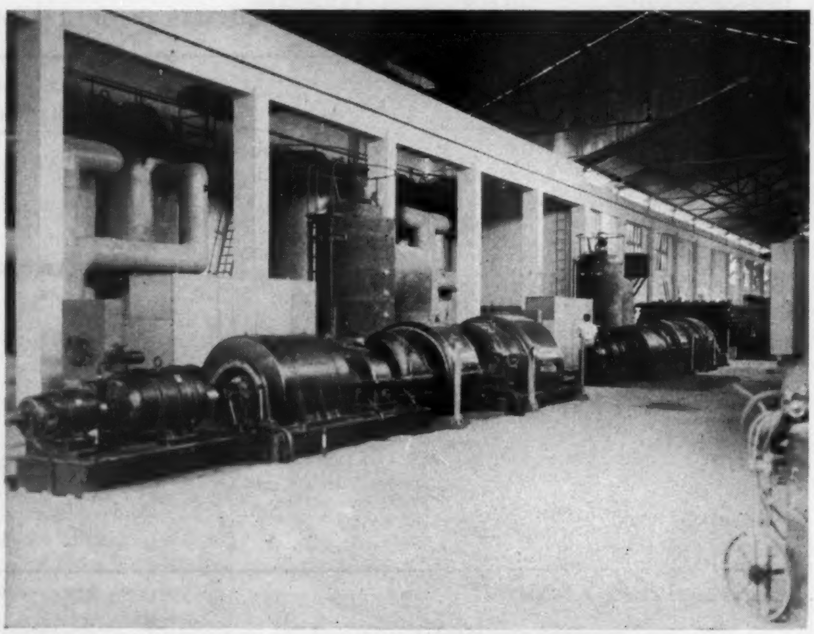

**Figure 1. Two 1650 KW units at Pertigalete, Venezuela.**

contact in the zone of highest temperature. This liner consists of a multitude of relatively small individual elements, in this particular case 250 elements in each combustion chamber. During a very thorough check-up after more than 9,000 hours of operation at the beginning of 1952 the number of such elements which were replaced in both combustion chambers was 40 or 8% of the total number installed. At this rate a complete replacement of the inner liner would only be necessary after about 12½ years of operation. The costs of these replacements to date have been almost negligible—about 0.1% of the equipment cost.

Figure 2 shows the Beznau gas turbine station in Switzerland with the 13,000 KW unit in the foreground and the 27,000 KW set in the rear. Although this station was conceived and built for firming up water power during the winter season, it has been regularly used during the last two years for peak load operation—a few hours a day—all through the year. Gas turbines are of course particularly well suited for such peak-load operation due to their rapid starting ability, 10-15 minutes from cold to full-load. No disturbances or unscheduled outages were experienced since some of the initial flaws shortly after erection were corrected. There have been no maintenance problems beyond the replacement of a few carbon brushes on the starting motors.

Both sets were originally designed for continuous operation with a gas inlet temperature of 1,100° F and short time peaks up to 1,200° F. During the summer of 1950 the smaller set was converted to operate continuously with 1,200° F and with peaks up to 1,300° F. This did not in any way affect the operating reliability since the change was made.

All the other gas turbines have shown the same operating record and this performance therefore fully confirms the expectations previously announced, namely, that maintenance costs of gas turbine units are in the same class as for steam turbines, i.e. almost negligible during the first few years. Replacements of some components, such as combustion chamber liners, gas turbine blades and possibly some recuperator elements will only have to be expected after 12-15 years of continuous operation.

### Operating Efficiency

It has been said in some quarters for several years—and is being said today—that gas turbines are not really interesting commercially as long as they do not operate at temperatures of 1,400° F or higher and then out-perform every other prime mover. This is often coupled with the contention that only in the temperature range from 1,350° F upwards will they have an efficiency that is worth considering.

The operating record of these 13 units—practically all of them using heavy fuel oil—shows that worthwhile results are obtainable without going to these high temperatures, where ash problems prevent continuous operation and cause serious difficulties.

The operating record of these 13 units proves furthermore, that we do not have to sacrifice efficiency by keeping within safe temperature limits. In all these installations efficiency guarantees have been met—notably with continuous gas inlet temperature averaging 1,112° F. The values given in table I are based on an ambient air temperature of 68° F and on the low or net heat content of the fuel. To allow direct comparisons, these figures should be converted to the basis used by others, namely 80° F ambient air temperature and the gross or high heat of the fuel. If this is done for a simple cycle unit without recuperator, with a nominal rating of 4,000 KW (similar to item 4 of Table I) and proper allowance is made for an output reduced to 3,500 KW, the resultant overall efficiency is 17% with an inlet temperature to the gas turbine of 1,112° F and still 15% with a gas inlet temperature somewhat below 1,000° F. Published accounts of another make operating under the same conditions indicate an overall efficiency of 15% with a gas inlet temperature of 1,400° F.

In the light of the preceding discussion it is clear that a temperature difference of 400° F has a very important bearing on the question of deposits and corrosion, or to put it differently, on the continuity of operation and the life of the equipment.

### Other Gas Turbine Sets Completed or Under Construction

It is a somewhat strange coincidence that several gas turbines completed quite some time ago—and designed for natural gas fuel—have been late in getting into operation, chiefly due to political reasons. This was true of the 10,000 KW set, item 13, and is true of two other sets, each of 4,000 KW for natural gas firing which were shipped to the Tembi plant of the Anglo-Iranian Oil Co., Ltd., near Abadan, Iran, late in 1950 and were ready for operation in June 1951. Regular operation was delayed on account of

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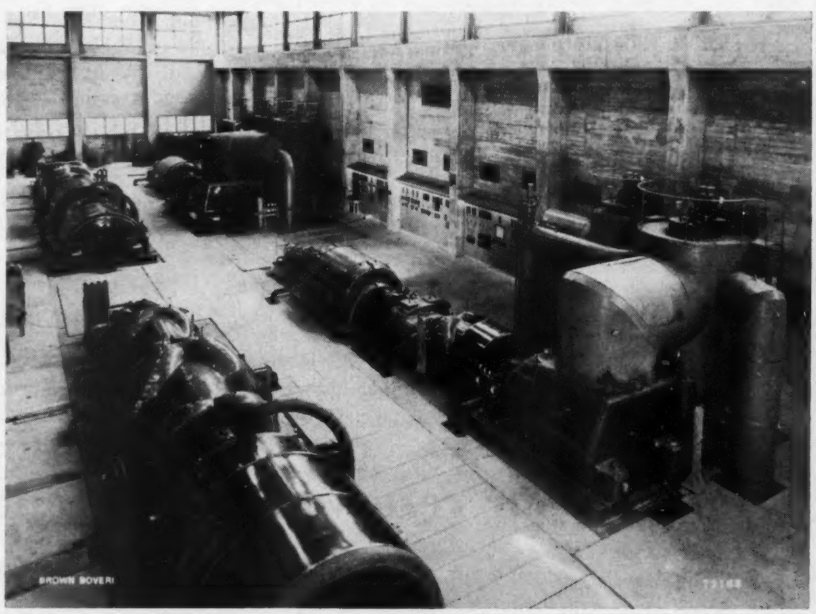


**Figure 2. The Beznau gas turbine station in Switzerland with the 13,000 KW unit in the foreground and the 27,000 KW unit in the rear.**

# WSE Excursion

## Come on Along!

## We're going on tour of Midway Airport

# May 16

The persons going on the special tour of selected facilities at Midway Airport in Chicago, will meet at 9 a.m. in the United Air Lines' auditorium on May 16. At this time groups will be organized and members briefed.

The groups will first visit a DC-6 air liner. The members will be given the opportunity of visiting the cockpit to learn about the controls and electronic equipment, and appurtenances that belong to the operating end of an air liner. Competent personnel will be on hand to answer questions.

The groups will next go to an Airlines' synthetic training department where they will see the operation of the Link Trainers which are used to assure the instrument proficiency of pilots.

Also visited will be an air line's Flight Dispatch and Operations Department. Here the groups will see the operations of the communications system and methods of flight dispatch, necessary to insure the safe and orderly operation of an air line.

For those who may have a special interest in the subject, including any wives who may be present, a tour of United Air Lines' Flight Kitchen will be made. In this kitchen approximately 2,000 meals are prepared daily for passengers on flights from Chicago.

A visit will also be made to the Civil Aeronautics Administration's Air Traffic Control Tower. Here, two-way radio communications and radar will be seen. These are used to guarantee the safety of arriving and departing air-line flights. During adverse weather conditions they assure on-time arrivals and departures, promoting greatly the reliability of the air lines.

Several other airport facilities, besides the ones listed above, will be visited. Anyone who makes a reservation is assured of an interesting, educational and pleasant time. Better yet, there will be no charge except for transportation about Midway Airport, unless a person wishes to have luncheon at the Marshall Field Cloud Room. We hope that everyone wishes to eat there. The luncheon is planned for 12:30 p.m. at the scheduled conclusion of the tour.

So come on along! We'll see you at 9:30, the morning of May 16. Don't miss us!

## Phone your reservation to Headquarters today!

**Phone RAndolph 6-1736**

# The Contributions of Engineering — to the Plastics Industry

By Frank C. McGrew

The contributions of engineering to the plastics industry have been substantial and indeed vital. The development of the plastics industry to its present size—production of more than one billion dollars worth of materials in 1951, even without including synthetic rubber — has mustered virtually the whole of engineering technology. Moreover, the rapid growth of the industry—averaging something like 15% expansion per year—has in many instances posed problems that demanded and inspired new engineering advances.

This interrelationship of the plastics industry and the engineering sciences presents an extremely varied panorama. In depicting it, I intend to pass a spotlight slowly across the whole sweep of the industry from the chemical raw materials to the consumer, and pause to admire particularly noteworthy or significant contributions as we come to them in turn.

I shall consider first the status of the industry as it represents past engineering accomplishments and then reexamine the picture with an eye to engineering needed for the future and probable trends in the continuing flow of engineering contributions to the industry.

### Monomers

Just as the plastics industry grew from the chemical industry historically, in present industrial practice the plastics industry takes the chemical industry as a point of departure. Some of the starting materials, such as cellulose nitrate, formaldehyde, phenol, and in more recent times, ethylene, had achieved significant stature as chemicals before they were utilized in the production of plastics materials. The demand of the plastics industry for huge quantities has, however, led to manifold expansion of the production facilities, which has in turn brought into play the latest advances in engineering as they apply to design, construction, and operation of efficient, modern chemical process facilities.

To take phenol as an example, this demand has resulted in the installation of large-scale efficient facilities for synthesis by several different processes including benzene sulfonation, liquid-phase chlorination, and vapor-phase regenerative chlorination. The published description of one of these modern plants has been called "an illuminating story of chemical engineering accomplishment." It is especially noteworthy that very effective use has been made of instrumentation, and this emphasizes the importance of the role played by the electrical engineer in chemical manufacturing today. Instrumental means of measurement and automatic control, which are required especially for successful operation of high-efficiency continuous-process equipment, have been a major factor in making the different chemical processes for phenol effectively competitive with one another. Even at this advanced stage of development there is no end to growth and change since the existing processes will shortly have to compete with yet another based on cumene oxidation, to which we can confidently expect that modern engineering skills will be applied as fruitfully as possible to insure commercial success.

I mentioned ethylene as a relative newcomer to the roster of plastic raw materials: in this case it is worth noting that increasing demand, contributed in large part by the plastics industry, has drawn forth in the newest sources of supply the engineering technology of the modern petroleum industry.

Among starting materials first developed to substantial commercial scale because of their importance to the polymer industry, styrene and butadiene are, of course, pre-eminent because of the tremendous expansions occasioned by the synthetic rubber program. Again these have required and received engineering research and development in all phases of process refinement, plant design and construction and factory operation.

I can only mention without detail some of the other important polymer raw materials such as the acetylene-based group, including chloroprene, vinyl acetate, and vinyl chloride, and urea and melamine, whose development has created special problems that were solved to the great credit of engineering. Much the same can be said of the acrylic monomers, vinylidene chloride, and maleic anhydride. Finally, one might mention materials as yet required by the plastics industry in relatively small volume such as hexamethylene diamine, adipic acid, dimethylsilicon dichloride, and tetrafluoroethylene, which have in common the fact that the engineering contributions they have received are manifold, varied, and successful. The industrial development required for plastics starting materials has also included, of course, many auxiliary components such as plasticizers, fillers, pigments, and stablizers.

### Polymerization

The term polymerization includes the processes by which these starting materials receive the chemical conversion into substances that are by nature more

*(Continued on Page 8)*

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Frank C. McGrew, Assistant Research Director, E. I. duPont de Nemours & Company, Wilmington, Delaware, presented this paper at the Chemical Industries symposium of the Centennial of Engineering on September 9, 1952 in Chicago.

*(Continued from Page 7)*
typical of the plastics industry than of the chemical industry generally.

It is here that engineers have wrought the revolution that replaced the kettle technology of our early years with the elegant continuous-flow reactors for large-volume polymers such as polystyrene, the butadiene rubbers, and vinyl chloride polymers. This was accomplished most spectacularly in the wartime synthetic rubber program, which is certainly the most important chemical engineering undertaking we have yet seen in the field of polymer manufacture. In the story that has already been told many times, it is made dramatically clear that the vast amount of research on products and processes, and the compression of planning and construction into a short span of time, constituted an engineering accomplishment of the first magnitude. This not only completed the establishment of the synthetic rubber industry as an economically sound national resource, but laid the basis for a considerable contribution to our economy in the form of plastic materials derived from the synthetic rubber raw materials.

In the field of polymerization, there are also mechanical engineering contributions particularly deserving of comment. One example is in refrigeration. The overbearing demand for precision of temperature control on polymerization reactors, where large amounts of heat are usually generated, has called for refrigeration systems of enormous capacity, requiring the best engineering knowledge and ability, for the production of polyisobutylene and especially cold butadiene rubber.

A second and perhaps still more spectacular example is provided by the high-pressure reactors typical of polythene synthesis. The success of this rapidly growing field of plastics manufacture is a tribute to the development of a system for pumping ethylene in continuous plant-scale operation at pressures of the order of 30,000 p.s.i. Similarly, reactor design in its metallurgical aspects, operation, instrumentation, and maintenance have required mechanical engineering insight and ingenuity of a high order.

Note should also be taken here of the importance of engineering research in the laboratory and pilot plant which, coupled with engineering experience in full-scale plants, has led to the choice among many alternatives for the physical state of the product. This has involved determining how polymerization in such forms as dispersions, beads, solutions, and bulk affects economy, product quality, and subsequent usefulness of the polymer.

**Fabrication**

At the end of the polymerization reaction, that is, when the principal chemical reaction is over, the operations encompassed by the plastics industry are just getting well started. In the vast majority of plastics uses, ability to fulfill the intended function requires a particular physical form. Ways to produce the desired forms have occasioned more debate, entailed greater variety of experimental trials, and elicited more numerous engineering contributions in the way of variety of equipment design than any other aspect of the plastics industry.

When thermoplastics appeared on the industrial scene there was, of course, well defined technology, of which the die casting process is an example, for the forming and fabrication of metals. Since the thermoplastic polymers possessed an outward resemblance to metals, it was natural for fabrication techniques to be taken rather directly from metal techniques. The principal difference in properties, the significantly higher viscosity of the melt in the case of plastics, offered no important barrier in the early techniques of casting and molding of small objects. With the recent rapid trend, however, toward larger moldings, this difference in viscosity has led to a troublesome dilemma. The formation of larger objects was possible only with very long times in the molding machine or excessive pressures. In either case, the economics of fabrication, upon which the advantage of plastics in many instances is based, was seriously threatened. Engineers have made progress in overcoming this difficulty with high-capacity automatic presses using pre-plasticizers to increase the effective heating surfaces of the molding machine; more progress is urgently needed.

On the thermosetting side of the plastics industry, fabrication methods can be viewed as modern descendants of some of the ancient ceramic arts. Molding of thermosetting resins involves, however, a vital chemical reaction carried out in the shaping machine and ingenious development has been required to permit the molder to maintain the necessary close control over this reaction. In working toward solutions to this problem, engineers have refined compression molding by adding streamlined preheating chambers (as in transfer molding), temperature-controlled nozzles (as in jet molding), or high-frequency preheaters. High-frequency or electronic heating provides a grati-

fying example of the application of the latest developments in electrical engineering to good effect in a plastic industry problem, the importance of this contribution is illustrated by the fact that high-frequency preheating may permit a reduction of press cycle time by 80% or more as compared to oven heating. The beauty of this technique from the engineering point of view is that it cuts to the heart of the problem of transferring heat into plastics materials—a problem encountered in place after place in this industry. What a prize awaits the man who devises an equally direct method of removing heat from plastics!

Before or during conversion to their ultimate physical shape, plastic materials are commonly combined with other materials to give composite end products. In this field of activity, which includes filling, laminating, fiber reinforcing, and foaming—all enginering operations —one of the most interesting engineering contributions is illustrated by the vacuum metal-coating techniques. Equipment with which to coat plastics with evaporated metals on an industrial scale at low cost, which has involved considerable creative engineering effort in high vacuum systems, represents one of the outstanding engineering contributions in this field in recent years. On another front in this same general region, we are now beginning to see the emergence of semi-continuous processes for the fabrication of reinforced plastic shapes.

To different degrees, problems of a similar nature have challenged engineering ingenuity in continuous fabrication of thermoplastics by extrusion, as in the production of flat film, both directly and by tube blowing, sheets, wire covering, tubing, and pipe. Blow molding and bottle making, bag molding and various post-forming procedures have required extensive modification of previously existing technology or completely new design to accomplish their special ends with materials significantly different in processing characteristics from the inorganic materials of the pre-plastics era.

Now we see a trend also to techniques of achieving final shapes by way of particulate forms of the resinous material, as dry powders, as water dispersions, or as dispersions in plasticizers (the "plastisol" and "plastigel" forms). The usefulness of flame spraying and of techniques employing plasticizer dispersions in the formation of protective coatings on surfaces, and for the assembly of composite structures such as coated fabrics, bears witness to the contributions that can be made by imaginative development of procedures economically suited to the properties of plastics. From a somewhat different point of view, techniques for extruding and forming compositions based on a particulate form of resin have provided the means for handling relatively less tractable materials such as polytetrafluorethylene.

### Applications

Let us pause briefly now to admire a few examples of the many hundreds of instances in which engineering contributions have been made to the formation of useful objects designed to translate inherent properties of plastics into functional characteristics beneficial to the consumer. The plastic tabletop constructed to be heat resistant by lamination with aluminum foil is a deserving example. Ceiling lighting employing acrylic resin diffusers to take advantage of the unique light-transmitting properties of this plastic affords a particularly pleasing example of what can be done in this way through the use of imagination in architectural engineering. Squeeze bottles made of pliable polythene show how a unique plastic property can be translated into functional characteristics of the ultimate object that serve the user directly. Myriad machine components such as gears, impact sections, bearings, and reciprocating parts designed to be made of nylon make effective use of the vibration-damping, low weight-to-strength ratio, and low lubrication requirement of this plastic. By way of combination of several plastics with different properties, it has been possible to produce such things as a durable, unsinkable lightweight boat.

In many of these applications, you will note, the successful engineering contribution to the design of a plastics object such as a mechanical part, created in turn a contribution of the plastics industry to engineering. Such contributions are represented by new materials of construction, more effective mechanical devices, better electrical and thermal insulation, etc. There are many other instances, in which it may be true that the contribution to engineering was greater than the contribution from engineering. Such a case might be, for example, the development of resin bonding, which offers the prospect, already partly realized, of revolutionary improvement in the creation of composite structures involving wood, metal, rubber, etc. These include important structures that are largely non-plastic in nature, both of the mechanical type such as brake shoes, and of the structural type such as aluminum airfoils.

In further elaboration of this line of thought, it is worth while to point out that engineering advances in other fields have created the needs and opportunities for certain plastics that started them on their successful careers. The development of radar and other microwave technology by way of electrical engineering created the initial opportunity for plastics with superlative electrical properties such as polythene and polytetrafluoroethylene, just as chemical engineering corrosion problems created the initial compelling demand for polychlorotrifluoroethylene and the civil engineer's continuing need for stabilization of soils to bear loads is bringing forth still other plastic materials.

### The View Ahead

It can hardly be doubted that engineering contributions to the plastics industry will continue to multiply in number, diversity, and value, in view of the present relationship and the prospects for continued growth of the industry at, at least, the present rate. Let us venture here to forecast a few of these possible contributions and to suggest what the plastics industry needs.

The advent of new monomers and to a considerable extent all new polymerization processes depends primarily on the research accomplishments of chemists. It is fair to emphasize in this connection, however, that the fruitfulness of chemical research in the synthesis of plastics and their starting materials, as in any other industry, may be importantly enhanced by engineering developments that extend the ranges of physical conditions in which syntheses can be explored. For example, in all likelihood we shall see the operable high-pressure limits pushed upward by engineering and reflected first in research and then

*(Continued on Page 14)*

# THE NEXT STEP...

..IN THE DEVELOPMENT OF AN ENGINEERING AND SCIENCE HEADQUARTERS

has been taken by many of the members of WSE, and sizable funds have been received or pledged.

However, our goal has not yet been reached. We ask, therefore, "Has the second step been taken by you?"

Charles E. De Leuw,
Chairman

D. Van Gorp
B. A. Gordon
G. L. Jackson
Co-chairmen

# Production Model of Calculator, Newest 'Brain,' now Installed

Installation of the first production model of the International Business Machines Corporation's newest and most powerful high-speed electronic calculator, the "701," at the company's World Headquarters in New York, was announced on March 27.

Designed to shatter the time barrier confronting technicians working on vital defense projects, the 701 is being manufactured in IBM's Poughkeepsie, N. Y., plant where production-line techniques of assembly and standardization are used.

Composed of eleven compact and connected units known as IBM Electronic Data Processing Machines, the 701 is the first calculator of comparable capacity to be produced in quantity. A total of eighteen will be built within a year, all consigned to government agencies or defense industries.

The calculators, which will rent for $11,900 monthly or more, depending upon storage capacity, will be used for the calculation of radiation effects in atomic energy; for aerodynamic computations for planes and guided missiles, including vibration and stress analysis, design and performance computations for jet and rocket engines, propellers, landing gear, radomes, etc.; on studies related to the effectiveness of various weapons, and on steam and gas turbine design calculations. A company which has pioneered the use of high-speed digital computers for cost accounting with the IBM Card-Programmed Electronic Calculator, will use the 701 to speed and simplify the immense task of assembling and interpreting production cost data from its several plants. In government agencies the 701 will be used principally on classified problems.

The 701 installed at IBM in New York will be operated as a Technical Computing Bureau for organizations having problems involving mathematical computations. These will include problems similar to those listed above, as well as geophysical calculations and commercial studies. Test computations now in progress include a problem relating to the electronic charge distribution in the nitrogen molecule.

In preparation for the use of this machine by American industry, a staff of IBM scientists has been engaged for two years in planning the economical solution of typical problems. One result of this work is that users of the machine need no longer be concerned with tracing the position of the decimal point through problems involving thousands or millions of sequential arithmetical steps.

Using a "floating point" technique the machine notes the position of the decimal point in the input numbers, keeps track of the point, and finally reports the position of the decimal point as the results are printed.

So much progress has been made in ease of use of electronic computers that in a course of only three weeks duration, IBM is able to instruct its Technical Computing Bureau users in the preparation of problems for the 701 and operation of the machine.

The 701 has at least 25 times the over-all speed but is less than one-quarter the size of IBM's Selective Sequence Electronic Calculator, which was dismantled to make room for its speedier successor.

During its five-year reign as one of the world's best-known "electronic brains," the SSEC solved a wide variety of scientific and engineering problems, some involving many millions of sequential calculations. Such other projects as computing the positions of the moon for several hundred years and plotting the courses of the five outer planets—with resulting corrections in astronomical tables which had been considered standard for many years—won such popular acclaim for the SSEC that it stimulated the imaginations of pseudo-scientific fiction writers and served as an authentic setting for such motion pictures as *Walk East on Beacon,* a spy-thriller with an FBI background.

Though the 701 occupies the same quarters as the SSEC, which it rendered obsolete, it is not "built in" to the room as was its predecessor. Instead, it is smartly housed between serrated walls of soft-finished aluminum. A balconied conference room, overlooking the calculator and separated from it by sloping plate glass, provides a vantage point for observing operations and discussing computations. Ample space is provided for writing the complex and abstract equations that are the stock in trade of engineers and scientists in an age of atomic energy and supersonic flight.

The 701 uses all three of the most advanced electronic storage, or "memory" devices—cathode ray tubes, magnetic drums and magnetic tapes. The computing unit uses small versions of the familiar electronic tubes, which are able to count at millions of pulses a second. In addition, several thousand germanium diodes are used in place of vacuum tubes, with resultant savings in space and power requirements.

The 701 was designed for scientific and research purposes, and similar components are adaptable to the requirements of accounting and record-keeping.

*(Continued on Page 16)*

*(Continued from Page 5)*

the political complications growing out of the nationalization of these properties by the Iranian government. A third identical unit which was ordered after the successful shop tests of the first two sets and intended for the same company is nearing completion at the factory.

These three sets are laid out for the simple cycle since the fuel gas has practically no market in that vicinity. Of particular interest is the starting arrangement by means of an expansion turbine which reduces the pressure of the natural gas from about 600 psig to about 80 psig at the inlet to the combustion chamber. This expansion turbine remains coupled to the set also during regular operation and contributes about 3% additional shaft output. Before entering the expansion turbine the gas is preheated to approximately 570° F to avoid jelling of certain components.

Another 5,000 KW set for natural gas firing, for the same Cement Plant in Venezuela where the 2 units, item 6/7 have been in satisfactory service for about three years, is now being erected at the plant.

Also under construction and getting near to completion are four new sets for natural gas fuel, each of 5,000 KW rated output, for several oil camps of the Arabian-American Oil Co., popularly known as Aramco. These units will also be of the single-stage, single shaft design, without recuperator. The normal rating is to be obtained with an ambient air temperature of 120° F and the guaranteed overall thermal efficiency, referred to generator terminals, is 17%. All four units will be shipped to Arabia during this year and two additional units with the same specification have recently been ordered.

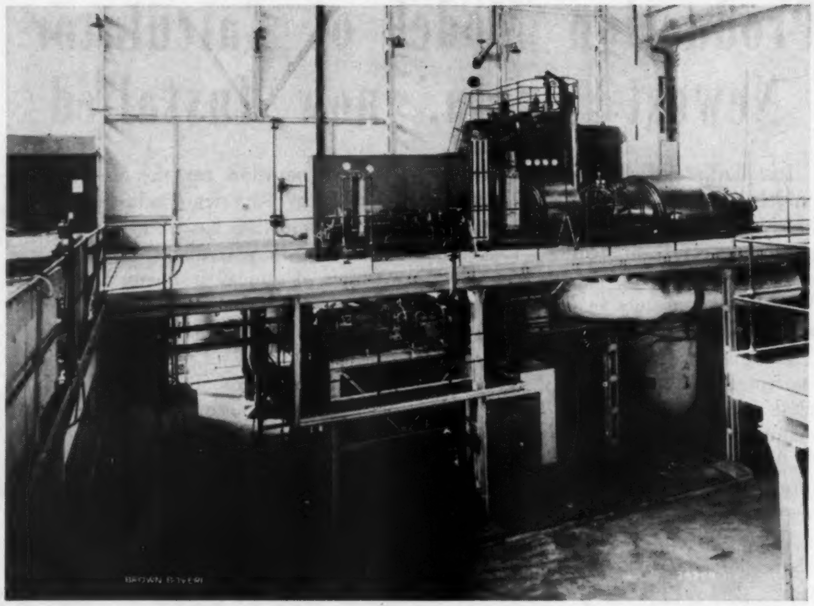


**Figure 4. The unit shown diagrammatically in Figure 3. The installation is at Baracaldo, Spain.**

Last year, Canadian Utilities Ltd. of Edmonton, Alberta ordered a gas turbine unit, closely similar to these Aramco units, also for natural gas fuel. Since this unit will have to operate also during the very cold winter season, with ambient air temperatures down to minus 40° F, its maximum rating is much larger, namely 7,680 KW. This unit will be shipped early in 1954.

### Gas Fired Installations

Natural gas is the ideal fuel for gas turbines and thus no operating difficulties of any kind need be expected with the units just mentioned. The same is, of course, true of other gas fuels, particularly blast furnace gas and coke-oven gas. Such applications are of particular interest for steel plants where, incidentally, cooling water may be scarce or of poor quality.

That such gaseous fuels do not present any combustion or ash problems has been conclusively proven by the record of many Velox boilers operating successfully with blast furnace or coke-oven gas for periods of 100,000 hours and more. Figure 3 shows the diagram of the gas turbine driven blower installation in a steel mill at Baracaldo, on the north coast of Spain (item 11 of table I). Here the useful output is taken out in the form

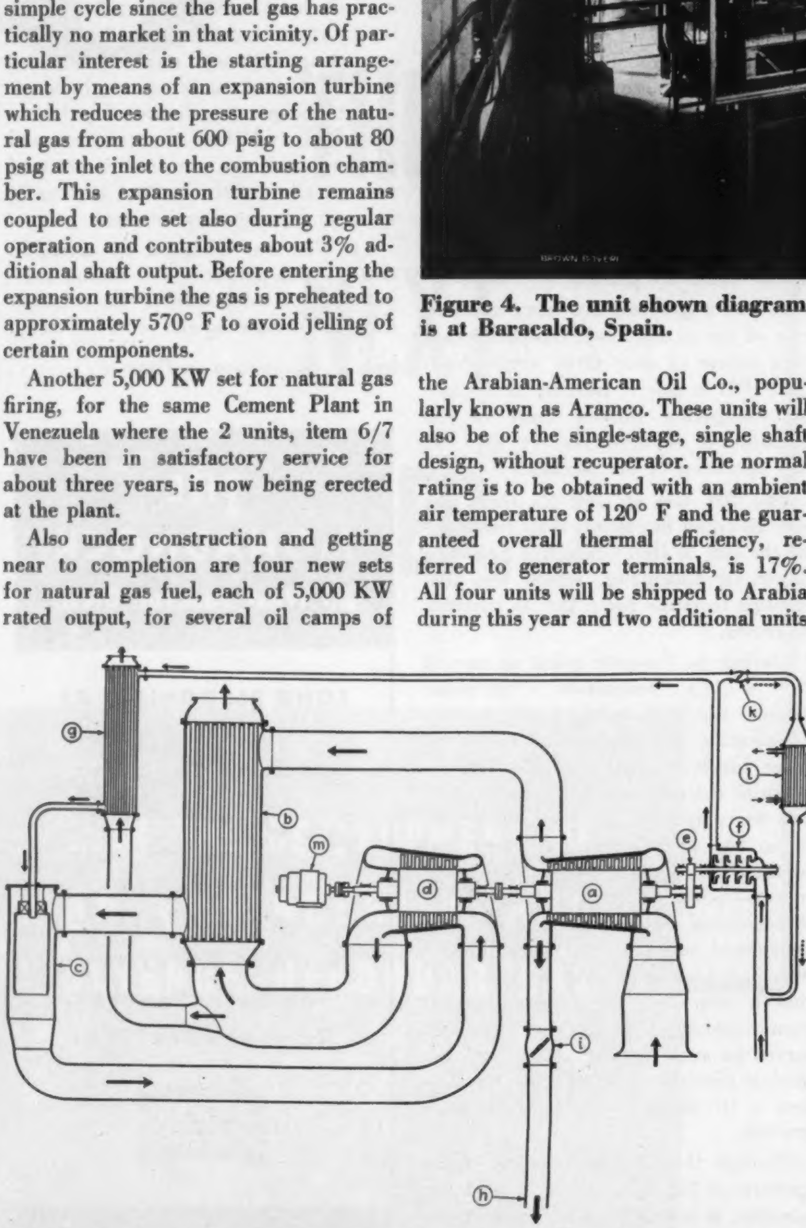



**Figure 3. The diagram of the gas turbine driven blower installation in a steel mill at Baracaldo, on the north coast of Spain.**

of compressed air for steel converters (pipe h, downwards). The blast furnace gas fuel is compressed in a centrifugal compressor f and also preheated in the recuperator g.

Figure 4 shows this installation. The maximum volume of converter air to be extracted from the axial blower in the center is 23,000 cfm at 25 psig. At the left end, slightly obscured by the large mercury guage, is the centrifugal compressor for the blast furnace gas fuel, driven through a step-up gear. Below the machine floor at the left end are some of the auxiliaries and controls. The horizontal pipe going to the right carries the converter air.

A similar arrangement but with generator coupled to the main shaft has been adopted in the plant of the Arbed Steel Works at Dudelange, Luxemburg, noted under item 12 in table I, with a nominal rating of 5,400 KW. This is also designed to deliver up to 47,000 cfm of air for blast furnace use at 18 psig or for use in steel converters at 29-30 psig. This air volume is extracted after the axial compressor, and controls are so arranged that the useful output may either be obtained as electric power or compressed air in any desired combination between 5,400 KW and no air delivery to no electric power and the maximum air delivery of 47,000 cfm.

This versatile and flexible unit is shown in Figure 5. Next to the generator in the center foreground is the axial compressor for the blast furnace gas fuel driven through an additional shaft of the main gear. At the right is the thermal control panel, the combustion chamber with its air and fuel gas inlet and a rather large recuperator, consisting of six vertical elements, arranged in hexagonal fashion with common inlet and outlet gas ducts. The outlet header is on top with exit to the right.

Since its setting to work in May, 1951 this set has had no unscheduled shutdowns nor any difficulties. After operating 4,200 hours by the end of 1951 a detailed inspection showed all elements in perfect condition and no sign of any wear. No expenses for maintenance have so far been incurred.

This set has aroused widespread interest among steel mill operators and has had an unusual number of visitors, including several dozen engineers from this country.

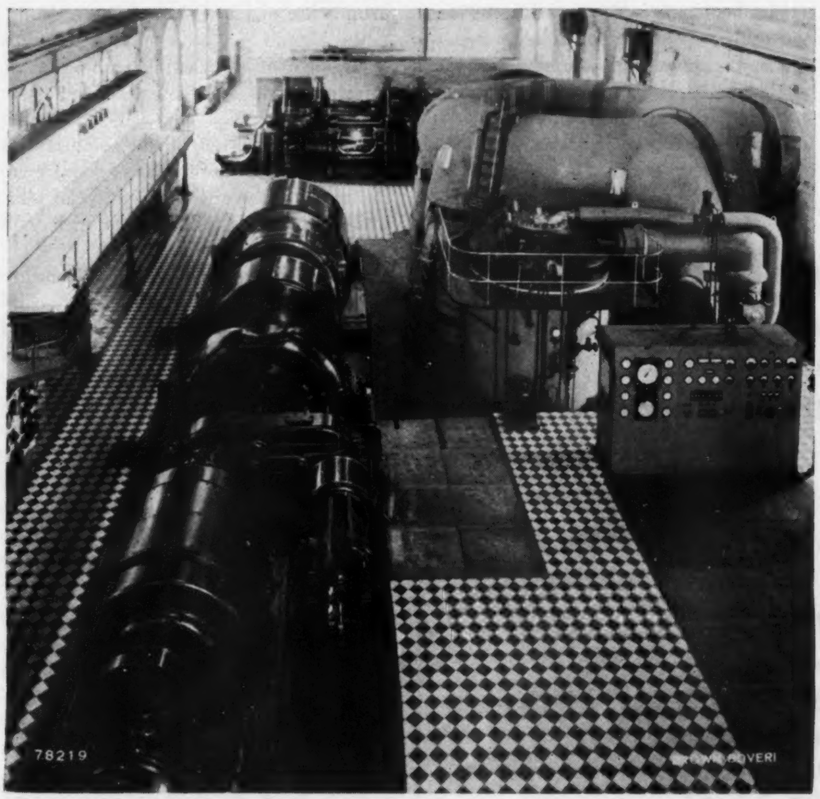



**Figure 5. Installation in the plant of the Arbed Steel Works, Dudelange, Luxemburg.**

## Summary and Outlook

To summarize these operating experiences, it may be said that reliable and trouble-free gas turbine installations have now been a reality for several years and may be adopted without any qualification where gaseous fuels are available. While natural gas holds a particularly prominent position in many parts of this country, also leaner gases, especially blast-furnace gas, offer interesting possibilities in the vicinity of steel mills. Fuel oil as standby is quite acceptable in most industrial plants.

Heavy fuel oils may be used with certain restrictions as to quantity and composition of ash contents and for plants allowing periodical short shut-downs for cleaning. When these restrictions are observed, reliable long time service will also be obtained from oil-fired plants.

As shown in detail, maintenance and servicing is of the same order as for modern steam turbine plants, namely insignificant. Also the useful life of the equipment should be no shorter than what is expected of steam turbine installations.

The major field of application for the next few years will no doubt be in small and medium sized units. Fully developed and tried-out designs in single-shaft arrangement are available in the range from 1,200 to 7,000 KW nominal rating in a total of seven standard sizes, for power generation or mechanical drives.

The larger and more complicated unit sizes in two-shaft arrangements while fully as reliable as smaller units are somewhat handicapped by the high cost of the additional heat exchangers and connecting piping.

A two shaft design, of nominally 12,000 KW rating similar to the three units already built and operated for several years is, however, available with or without recuperator and for operation with oil or gas fuels, especially also blast furnace gas. Larger capacity sets such as the 27,000 KW unit at Beznua may well await further development in metallurgy and fuel chemistry, permitting advances into higher operating temperatures before such units find a broad and economical use in comparison with steam plants.

## Plastics Industry

*(Continued from Page 9)*

in manufacture of plastic materials. Is it not also possible that the available pressure range will be extended in the opposite direction also, as engineering provides economical means first for research and perhaps later for chemical manufacturing at lower and lower subatmospheric pressures? Engineering techniques for producing high temperatures and for effecting rapid cooling from those temperatures will be refined and followed by increasing utility in the plastics industry.

Whatever the environmental condition in question or whatever the direction of possible extension, let us underestimate neither the ability of engineering research to provide it nor the ability of chemical research to discover the usefulness in chemical synthesis that makes it an asset to industry.

Along with this expansion of boundary lines, it is probable that we shall see the chemical aspects of monomer and polymer synthesis become more and more involved. This will introduce new problems, but more importantly it will increase the premium on ingenious simplification of equipment design. We need, and I believe we shall have in the course of this evolutionary process, simplification of process equipment by reduction of overdesign features and by telescoping of unit operations into equipment of multiple function. Indeed, we must have the continuing advance in economy provided by this kind of engineering sophistication in order to realize the full potential of plastics in our industrial society.

The recent accomplishments of electrical engineers with high-capacity, high-speed electronic computers suggest that we may be on the threshold of an extremely interesting and productive new development in chemical engineering. As these machines become available for industrial use, we should see them applied to problems of design and operation of complex multi-purpose chemical process equipment, with resulting long steps forward in efficiency and economy of manufacturing plastics materials.

In the plastics industry we are conscious of continuing development in chemical process technology and realize that we must be alert to embrace the advances where they are applicable. In polymerization processes, for example, where high molecular weight solids of inherently high viscosity are being made, heat is being generated, and temperature must be controlled, we are eternally aware of the heat-transfer problem thereby presented and await eagerly the suggestion of novel and of more effective ways of designing to solve this problem.

Our need for advances even in such conventional and unglamorous operations as drying, mixing, pelleting, packaging, and the like is still acute, since too often now the cost of such operations is out of all proportion to the ultimate utility they confer on the material passing through. One way to meet this need, already apparent in the trends of equipment design, is the multiple-purpose converter, illustrated by the extraction extruders, which with their auxiliaries perform most of these functions in a single installation.

The conversion of plastics from bulk form, e.g., molding powder, to finished shapes is an area in which we should see further extensive and rapid change. Some of the great multiplicity of machines and techniques available today will pass from use, as others evolve in the direction of greater effectiveness and versatility with minimum cost. This area presents a major opportunity for new concepts that will revolutionize present methods of conferring shape on plastics products. A good guess today would be that extrusion techniques will come to be used in the shaping of a greater proportion of plastics products.

We should not be surprised to see a resurgence of the casting technique for forming plastics, because of the basic advantage of such a simple operation. Effective realization of the potentialities of this method may perhaps require innovations in the chemical nature of plastics to combine fluidity in the melt with faster setting in the mold.

We shall certainly see in the future more use and more varied use of composite structures, in which the inherent properties of plastics are joined with the inherent properties of other structural materials such as paper, glass, metals, and particulate inorganic materials to produce combined effects, impossible with individual components alone, that come ever closer to perfection in the satisfaction of the needs of the ultimate users.

Whether the simplifying solutions for plastics industry problems come to us from engineering by a chemical or a physical or a mechanical approach, we should see more and more use of plastics to perform ultimate functions now being served by metals. In this connection, however, let us note that the development of the shell-molding process, employing resin binders for foundry

sand, promises to bring about a revolution in casting of metals. As this revolution progresses, it will in all probability afford an economic advantage to metal shapes of certain kinds that will make them more difficultly replaced by plastics. Here is a case where engineering in the plastics industry is strengthening the position of a major plastics competitor!

In coming to the end of this appraisal, let us consider the subject on a more philosophical plane. Speaking generally, the plastics industry may be regarded as consisting of two parts; the first in which raw materials are converted to polymers by chemical reactions, that is, are supplied with their chemical form, and the second in which the polymers are manipulated by essentially physical processes to give the articles as eventually used, that is, are given their physical form. The portion of the industry involved in establishing chemical form has profited from the remarkable and gratifying development of chemical engineering in the last few decades. In my opinion, however, the second portion of the industry, which spans the path of the plastic material from the end of the polymerization reactor to its finally used form, has not been as fully developed and offers the greater challenge to engineering of the future.

I mentioned earlier that the machines for injection molding were direct descendants of the machines for die-casting of metals. I suppose it was historically inevitable that the new industry would thus borrow from the old in its early days in spite of the dissimilarity of the materials to be handled. Does this necessarily mean that this provides the best approach to the problem of conferring form on plastics materials? I think not. Is it inevitable that plastics materials should be taken from the reactor, converted first to pellets, spheres or cubes, packaged, shipped, remelted portion by portion, and pressed into a cavity by a piston? Let us remember that from the point of view of the ultimate utility of the shaped plastic object, it is of no concern whatever what path, in terms of physical form, the material has followed from the end of the reactor. We need to have engineering applied to the whole problem of discerning and implementing the most efficient ways to proceed from the end of the polymerization reactor to the finished shape ready for use.

Let me suggest that it is time for an intensive and concerted fundamental approach to this problem by way of engineering research. Since the key operation involved is the flow of material in a plastic state, one way of mobilizing this fundamental approach may be to start with the rheology of viscous melts and establish the fundamental engineering basis for the propulsion, shaping, and cooling of such materials.

In this connection, let me plead a case for the need of the plastics industry for further development in engineering education. A fine start has been provided by many engineering schools with worthy curricula for training in plastics engineering. These should be expanded for the training of more engineers and for continually increasing the preparedness of engineering graduates to analyze the problems of the plastics industry and to develop their solutions.

I have alluded to the filling of needs as a goal of the plastics industry. It must surely be clear that the value of finished articles in the market depends upon how well they will serve their intended functions in the hands of the final user. Since the market value determines the monetary reward for the plastics industry operations involved and thereby their commercial success or failure, we must aspire to ever increasing proficiency in the satisfaction of needs. To accomplish this at steadily diminishing cost will be the highest aim of the plastics industry, and accordingly the criterion by which engineering contributions of the future will be judged.

## Glossary of Terms Just Off the Press

A Glossary of Terms Used in Methods, Time Study, and Wage Incentives, just published by the Society for Advancement of Management, promises to cut down previous wrangling, aimless discussion, and hair-splitting interpretations over contract language. It is said to be an authentic reference for both management and unions alike.

Ninety-three management leaders of the Society, working through its Research Division, spent four years compiling the 332 definitions that appear in the Glossary. It represents the best thinking and most practical fundamental guidance that has been brought to the areas of cost accounting, time study, wage planning and administration, arbitration, methods engineering, sales planning, and personnel practices since the days of Frederick W. Taylor.

Within the mechanics of management itself, the Glossary will dramatically reduce the merry-go-round communications, and help bring about greater concert of effort toward better understood goals.

Each of the 332 terms and expressions in the Glossary is defined on the basis of its interpretation by the greatest number of experienced people using them professionally and successfully.

Cast into an attractive vest-pocket format, the Glossary is as convenient to handle as it is informative. The Glossary is No. 104 of a series of publications issued by the Society for Advancement of Management, 411 Fifth Avenue, New York 16, N. Y. It is priced at $1.00 per copy.

## Calculator

*(Continued from Page 11)*

Research on commercial data processing machines is under way.

The 701 is capable of performing more than 16,000 addition or substraction operations a second, and more than 2,000 multiplication or division operations a second. In solving a typical problem, the 701 performs an average of 14,000 mathematical operations a second.

Internally, the 701 performs operations in the binary number system. All initial data and final results may be in the familiar decimal number system. High-speed conversion between number systems is handled automatically by the calculator.

But speed alone is not enough. To be able to solve the problems of enormous mathematical complexity attending the defense effort, a computer must also have prodigius storage capacity and extreme flexibility. Further, it must have input and output systems that are both fast and efficient.

When the outbreak of hostilities in Korea made the production of devices embodying all these components imperative, IBM was ready with the necessary prototypes. Its years of research and development in the field of computing already had produced the Automatic Sequence Controlled Calculator, first of the so-called "giant brains," and the Selective Sequence Electronic Calculator, as well as approximately 1500 Type 604 Electronic Calculators and Card-Programmed Electronic Calculators for business and industrial use.

The present emergency clearly defined the need for a calculator that would take a front-line position in the preparedness program—one capable of solving hitherto insurmountable engineering and scientific computing problems and eliminating many costly and time-consuming trial-and-error methods, while helping to relieve the shortage of technically-trained personnel.

The new computer can solve problems involving partial differential equations, ordinary differential equations, integral equations, matrices and combinatorial analyses. Partial differential equations occur, for example, in calculating the rate of flow of heat in the skin of a supersonic missile; ordinary differential equations arise in calculating the expected flight characteristics of the missiles; integral equations arise in calculating radiation intensities; matrices arise in component analyses in petroleum products and combinatorial analyses arise in strategic and tactical considerations.

The need for an electronic machine which will carry out thousands of operations a second is illustrated by the fact that the solution of a well-known partial differential equation useful in aircraft wing design requires 8,000,000 calculating steps per case.

The solution must be carried out step by step. Thus step 100 cannot be computed until the result of step 99 is known. Consequently, only one man, working with pencil and paper or one machine, can be occupied with the problem at any one time. The 701 completes the solution in a few minutes. A man working with a desk computer and using the same method would require seven years.

The banks of cathode ray tubes in the 701, known technically as electrostatic storage units, comprise the heart of the machine through which all information to and from all other components must pass.

The tubes—each resembling a smaller version of the picture tube used in television sets—can store the equivalent of 20,000 decimal digits on their screens by means of the presence or absence of charged spots. In a few millionths of a second, any digit stored on a tube screen can be selected for use, with a scanning electronic beam "reading" the charges and converting them into electronic pulses. These pulses are interpreted as numbers or calculating instructions.

The computer's magnetic drums—swiftly spinning cylinders surfaced with a material which can be easily magnetized—can store the equivalent of 80,000 decimal digits, any of which are available for use thousands of times a minute.

The magnetic tapes used in the 701 are similar in appearance to those em-

ployed by home sound recorders. In the new computer, each reel of tape can store 2,000,000 digits. Since fresh tapes can readily be substituted for those "filled" with digits, magnetic tape storage in the 701 is unlimited, for all practical purposes.

Components of the 701 include an Electronic Analytical Control Unit, an Electrostatic Storage Unit, a Punched Card Reader, an Alphabetical Printer, a Punched Card Recorder, two Magnetic Tape Readers and Recorders, (each including two magnetic tapes), a Magnetic Drum Reader and Recorder, and units governing power supply and distribution.

A typical problem is handled by the the 701 in this fashion:

All pertinent numbers, representing both the digits to be processed and instructions as to the procedure to be followed, are fed into the computer and automatically transmitted to the Electrostatic Storage Units.

The instant the machine has the data necessary to solve the problem, it begins computing. This is done by the arithmetic and control circuits of the Analytical Control Unit, which take numbers from the Electrostatic Storage Units according to instructions and perform any combination of arithmetic operations desired.

By means of the instructions provided the machine prior to the start of computing operations, the control circuits will make decisions as to the steps required to complete the solution of the problem without intercession by the operator.

When the computing is completed, step by step, the results are stored back in the Electrostatic Storage Units. If so directed in the preliminary instructions, the machine will then print the results by means of a 150 line-a-minute printer at the rate of 1,050 ten-digit numbers a minute. For compact storage and high-speed input and output, the 701 will transmit results to magnetic tapes at a rate equivalent to 1,250 ten-digit numbers a second. Also if desired, the machine will punch the results in standard punched cards at a rate equivalent to 2,400 ten-digit numbers a minute.

In the case of problems involving more digits than can be conveniently stored in the Electrostatic Storage Units, the figures and calculating instructions are stored on the magnetic drums and tapes. When these are needed for use by the arithmetic circuits, they are automatically transmitted to the electrostatic memory components and the operation proceeds as outlined above.

## Crerar Library News and Notes

Materials for the collections of the Library come from many sources. While a major portion of the items annually received come through purchase, the growth of the Library is immensely strengthened by gifts. This can be illustrated by a brief review of materials relating to railroads which were received as gifts during 1952.

Generous gifts were received from railroad organizations in England, Germany, Japan, the Netherlands, Norway, Spain, Sweden and Switzerland. For example, the annual report and minor publications as well as numerous books on railroading, were received from the *Nederlandsche Spoorwegen*, and from Germany came *Die Bundesbahn*, a monthly journal published by the Deutsches Bundesbahn, annual volumes since 1950 of the *Jahrbuch des Eisenbahnwesens*, as well as the collected papers on railroads by Wolfgang Baseler of the German National Railroads.

Also on the international level, the Library receives the publications of the Institute for World Railroad Documentation, whose headquarters are in Amsterdam, and the Annual bulletin of transport statistics of the Transport Division of the Economic Commission for Europe, UNESCO.

The American Association for the Advancement of Railroads has followed its practice of sending the publications of that important organization, and many reports and minor publications have come directly from American railroads. The Erie Railroad, the Illinois Central and the Baltimore and Ohio have contributed duplicate copies of several of their publications for the Library's use in foreign exchange.

A collection of special interest relates to street railways. It consists of portfolios of clippings, photograph albums, films, slides and pamphlets collected by the late Fred J. Borchert of Chicago. The collection was donated to the Library by Mr. Borchert's sister.

## Solar Energy Heating to be Used Widely

In another hundred years or so, coal will remain an important source of energy in this country but the use of oil and natural gas as energy sources will be rare. From the standpoint of conserving our present energy sources, the use of solar energy offers vast possibilities, in the opinion of Dr. R. C. Jordan, head of the mechanical engineering dept., University of Minnesota, and president of the American Society of Refrigerating Engineers.

In discussing solar energy and its engineering potentialities, at a meeting of the Illinois Chapter, American Society of Heating and Ventilating Engineers, on March 9, Dr. Jordan used slides to show that our solar energy is a tremendous source of untapped energy, enough of it being available in a relatively small portion of the southwest part of the country to take care of the energy needs of the nation. He pointed out, however, that to date conversion efficiencies obtained have not been notable. In fact, he reported that at present there is no efficient means of utilizing solar energy as a source of power. In his opinion, a 15% conversion efficiency from solar to electric energy is feasible.

With respect to the heating of buildings, the speaker indicated that solar energy can be utilized to handle 80 to 90% of the season heating load of structures located in fairly northern latitudes, Boston and Chicago, for example. It was also pointed out that the use of solar energy for heating requires a means of storing heat, of which a number were described, and a means of auxiliary heating. Dr. Jordan recommended the use of vertical walls or surfaces for the location of solar energy collectors.

A potential application which the speaker mentioned as offering attractive possibilities is the use of solar energy in conjunction with heat pumps. Since a structure heated by solar energy requires auxiliary means of heating, the heat pump could be used for this purpose. In addition, it provides summer air conditioning.

## Time Study, Methods for Lower Total Costs Subject of Conference

"Time Study and Methods for Lower Total Costs" was the subject of the eighth annual Industrial Engineering Conference of the Society for Advancement of Management, held Thursday and Friday, April 16 and 17 at the Hotel Statler, New York City. The Conference was sponsored jointly by the SAM and the management division of the American Society of Mechanical Engineers.

Over 2,000 industrial engineers from the United States, Canada and other countries attended the two-day Conference.

**Society's Award Winners Announced**

Two SAM awards were presented at the Thursday evening banquet. Dr. Marvin E. Mundel, director of the Ordnance Corps Management Engineering Training Program, Rock Island Arsenal, and former professor of industrial engineering at Purdue University, received the Gilbreth Medal. The medal is presented annually by the Society to an individual for distinguished service to the industrial engineering movement in the field of motion study. The medal is awarded in honor of the work done by Frank B. and Lillian M. Gilbreth. Phil Carroll, professional engineer, Maplewood, New Jersey, received the Society's Industrial Incentive Award. The award was established by the industrial consultant firm, Rath & Strong, Boston. The award is made to the industrial engineer making the greatest contribution in the fields of financial and non-financial incentives, performance standards, and time study during the year.

Lawrence A. Appley, President of the American Management Association, was the speaker at the award dinner. In discussing "Managing for More," Mr. Appley described how methods engineering, increased productivity of the work force, product research and development, market research and development, and management development, must be directed to continue our gains in the national standard of living.

Mr. Appley was the recipient of the Society's 1952 Human Relations Award.

On April 16, M. W. Mackenzie, executive vice-president, Canadian Chemical & Cellulose Co., Ltd., Montreal, discussed "Canada's Prosperity and the United States" at the luncheon session.

On April 17, Harold F. Smiddy, vice-president, Management Consultation Services Division, General Electric Co., and the Society's vice-president of Management Research and Development, described future "Horizons for Industrial Engineers" at the luncheon meeting.

**Synthetic Standards Panel**

At the final session of the Conference on April 17, the three newest and most widely discussed methods for arriving at synthetic work standards was explained and discussed.

## Atomic Shock Waves Least Affect Wood

Wood houses should withstand the shock waves from an atomic blast better than most other types of home construction in the same area, Leo Bodine, Executive Vice President of the National Lumber Manufacturers Association, declared on March 26 in Portland, Ore.

Mr. Bodine said that properly built wood houses could be counted on to resist atomic explosions certain distances away because of wood's "resiliency and capacity to absorb shock with little or minor damage."

He told an annual meeting of the West Coast Lumbermen's Association that one of the two wood houses exposed to an experimental atomic blast near Las Vegas, Nev., last week "was deliberately placed close enough to 'ground zero' to insure collapse."

This was done, he explained, "to test the effectiveness of personnel shelters built in the basement" of the home.

"Actually," Mr. Bodine asserted, "houses built of wood probably would have a better chance of surviving the shock wave from atomic blasts than do most other types of dwelling construction if, as is generally conceded, residential areas will for the most part be away from the industrial areas at which an enemy will aim his bombs and beyond the perimeter of shock waves of a magnitude causing total destruction.

"This is another way of saying that the shock of an atomic bomb exploded in an industrial target area will be dissipated as it reaches the residential sections . . . in about the same way as severe earthquake tremors are dissipated as the distance from its center increases.

"Experience in every section of our country that has suffered earth tremors affords indisputable evidence that structures of wood, because of their ability to absorb shock, survive such stresses and strains much better and with less damage than do most other forms of dwelling construction."

# New Technique Devised to Arrest Lean of Pisa Tower

The Leaning Tower of Pisa, one of the wonders of the world, has been tilting more and more for the past 600 years but Charles B. Spencer, one of this country's top foundation engineers, have devised a technique to arrest the increasing lean.

Mr. Spencer contends, in an article appearing in Engineering News-Record, McGraw-Hill publication, that with a little help from man, the tower could last another thousand years. Italian engineers have estimated that the world-famous landmark will collapse in about 200 years unless remedial measures are taken. The tower is now more than 14 feet out of plumb, comparable to an 180-foot building whose base is at the building line and whose top leans over the sidewalk and projects out beyond the curb.

The tower, built on a poor foundation, leans because the center of the consolidated soil, or sub-foundation, deviates slightly from the center of gravity of the tower. As a result, the two opposing forces pushing in different spots cause rotation, and the tower tilts. The simplest way to correct this is to supply a force tending to produce rotation in the opposite direction.

The most practical method, according to Mr. Spencer, would be to take away some of the material foundation on the high side of the tower. Reducing the soil consolidation on that side, by cutting away part of the sub-foundation, would move the center of the remaining support toward the low side and the center of the load. Any settlement on the high side, resulting from the procedure, would help to improve the situation.

Mr. Spencer says this method could be successful if carefully planned and executed, but it would have to be done slowly and no permanent benefits could be expected for about ten years. It also would have to be something of a trial-and-error procedure since no accurate computation can be made of the stresses involved.

Numerous other methods have been suggested, and some attempted, to arrest the lean but they are discounted by Mr. Spencer as being either unsightly, which would reduce the tourist value of the tower, or too risky. He admits that there is no precedent for his method but notes there is no precedent for the Leaning Tower either.

Tourists are always amazed at the sight of the tower which, experience suggests, should not be standing at all. Actually it stands virtually intact, the only visable damage being a slight cracking in a few of the outside columns which have been reinforced with steel bands. The nearby cathedral has undergone similar settlements which by 1825 were so serious that part of it had to be taken down and rebuilt.

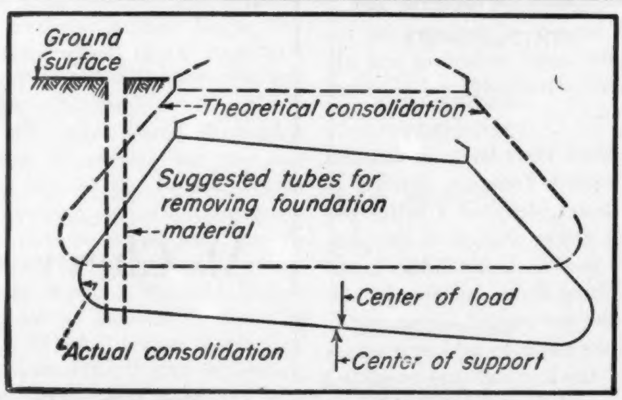
The tower is built on soil that today no modern building code would permit to carry more than half a ton per square foot. Yet the actual load under the tower foundation is about eight tons per square foot, the article says.

"It is my opinion that the tower actually is supported on a truncated cone of consolidated soil, extending from the underside of the tower down to a clay layer about 35 feet below the surface, and about 90 feet in diameter at the latter level. If this is correct, unit load on the lower clay is less than two tons per square foot, which such material should be capable of supporting. Unfortunately, the loading is eccentric and tends to become more so as the lean of the tower increases. The consolidated soil beneath the tower attempts to compensate by 'bridging out' farther on the weak side. However, increased consolidation involves further settlement and further tilting, and the process will continue until the center of gravity of the tower moves beyond the danger point," Mr. Spencer explains.

Settlement and tilting, accompanied by the consolidation process, has continued over the 600 years to date. While there is no record of the tower's original elevation, it is Mr. Spencer's opinion that it has settled about 12 feet on the low side and about eight feet on the high side, and that this amount of settlement proceeding at a slow rate over the centuries has saved the structure fróm complete collapse.

Within the tower, the Italian authorities have constructed a special room with a level floor about 30 feet above the ground. In this room they have placed a plumb line extending to the roof, an accurate level and seismographs to check on any earth movements that might be immediately disastrous. Continuous readings on these instruments show that the tower is increasing its lean at the rate of .04 inches per year. On this basis Italian engineers estimate that collapse will not occur for about 200 years, the article says.

*(Continued on Page 20)*




**Foundation diagram of the Leaning Tower of Pisa shows that, although the poor foundation has been improved by consolidation, the dangerous deviation between the center of support and the center of load causes the leaning and needs to be eliminated. Careful and controlled removal of some of the foundation material on the high side, thereby moving the center of the remaining support toward the low side and the center of the load, is suggested.**

*(Continued from Page 19)*

"However, as it leans, its center of gravity moves towards the low side, so I believe the rate of lean will increase, and the tower must be declared unsafe within 100 years," Mr. Spencer comments.

The construction of the tower was started in 1174, with the foundation consisting of a large ring of masonry about 20 feet wide and about 60 feet in exterior diameter, bearing on the soil, it is believed, only a few feet below ground level. The soil probably consisted of a wet volcanic silt, called in some accounts fine sand and clay, and if anything had been known at the time about the bearing values of soils the tower would never have been built.

By the time three stories of the structure had been completed, it was tilting at an alarming rate. In those days, the cities of Florence and Pisa were not too friendly, the magazine relates, and ugly rumors of deliberate sabotage began to circulate. The Florentine, named Bonanno, who was supervising the building, thought it was time to leave town, so construction was abandoned.

Sixty years later, the soil seemed to have consolidated, and settlement of the building stopped, so that Giovanni de Simone decided to finish it. Another story was added and attempts were made to straighten the tower by adding additional courses of masonry on the low side. But again settlement and tilting increased alarmingly, and Giovanni disappeared.

One hundred years later, an architect of Pisa, named Tomasso, decided to finish the tower, designed a belfry and made other minor changes in the plan. Nothing is known of any further settlement and tilting during construction, except that the practice of attempting to straighten the tower by adding masonry courses on the low side was continued until, on completion, the low side was nearly three feet longer than the high side. The tower was finally finished in 1350 and there is every reason to believe that the settlement and tilting have continued to the present, Mr. Spencer says.

# "Raise the Lead Curtain" Col. Carey of A.S.C.E. Asks

Unless the "lead curtain" now delaying private development of atomic energy is lifted, it will be impossible to proceed with peace-time benefits of that power, Col. William N. Carey, of New York, Executive Secretary of the American Society of Civil Engineers, warned on April 20 in Minneapolis.

Col. Carey, a native of Minnesota, is a distinguished engineer in several fields of the profession and a frequent spokesman both in the United States and abroad for American engineering. He was the principal speaker at the annual University night meeting of the Minneapolis Engineers' Club held in Coffman Memorial Hall at the University of Minnesota.

In portraying present engineering education processes, despite their excellent contributions to the profession and to the country's development, as "too shallow" and "Specialized" and as being inadequate for a future that will be fashioned largely by atomic energy developments, Col. Carey called upon engineering schools to prepare educational programs sufficient for the industrial revolution that atomic energy spells for years ahead.

Looking to the time when coal bins and fuel-oil tanks may become empty and a new source must be sought, even though we may learn to apply the power of solar energy, Col. Carey said that "it is heat from fission which today carries the best promise for practical industrial development."

Citing the belief of private power experts, Col. Carey pointed to the construction of the atomic powered electric station as soon as the Government permits and it can be shown to be a good investment for capital. He went on to observe:

"This does not appear likely soon, although certain private power groups with private funds and in close collabora-

# A Date to Remember

## *Aug. 15*

## At Chevy Chase Country Club

### WSE'S 4th Annual Golf Tournament

### (Details Later)

tion with the Atomic Energy Commission are continuing limited study and experimentation in the electric power field. Private development, however, is impossible in any important degree under present laws aimed at security and secrecy in the general program. A lead curtain has been dropped around our atomic discoveries and developments.

"Much properly public information is kept restricted by several Federal departments behind a shield of alleged national security. Recent press stories indicate that AEC and certain Congressional committees are now reviewing some of the laws and security regulations relating to atomic energy and other public matters. Revisions should be made in the interest of common sense and public good without sacrifice of security. A proper combination of private initiative and flexible governmental supervision appears essential for maximum progress in least time."

Recalling that AEC now employs directly about 14,000 engineers and scientists, Col. Carey pointed out that "atomic energy is even now the largest new employer of scientists and all types of engineers" and is the nation's third largest business, outranked in permanent assets only by Metropolitan Life and American Telephone and Telegraph.

With the atomic world certain to come, Col. Carey said that "reorientation of some of our educational processes in enginering no longer can be postponed." He said he shared the belief of many engineers, engineering educators and industrialists that, "on the average, our educational pattern is too shallow and too specialized for best meeting present national needs, to say nothing of the engineering requirements of the future."

The nation's industrial program has outpaced engineering education processes and vast industrial expansion created a demand for mass production of engineers, said Col. Carey. Estimating today's census of engineers at some 400,000, the speaker added that "demand for quantity has been met at sacrifice of quality, but we had to have quantity and the quality is good enough." But while good enough for the immediate past the quality will not be adequate for needs of the future, said the speaker. Col. Carey said that "mass produced or not, engineering educators and the engineering profession have no reason to apologize for the important and essential part engineers have played in our unprecedented industrial development."

The 400,000 we call engineers today, said Col. Carey, are "a confused mixture of truly professional engineers and engineering technicians." He went on to say:

"We must re-design our educational processes so as to develop the truly professional engineers needed and we must expand greatly the educational plant and personnel necessary to produce large numbers of first-class engineering tecnicians. In spite of the hue and cry over the shortage of engineers, many engineer graduates are working in industry and the armed forces as engineering technicians. When engineers are not fully utilized as such, there is a waste of valuable and scarce manpower."

Col. Carey said that the country probably does not need more than 200,000 to 300,000 truly professional engineers, but does require half a million or more well-trained engineering technicians.

Extolling the achievements of present engineering education processes in the circumstances he had outlined, Col. Carey remarked that the high quality of these processes "is amply attested by the public demand for the product and the fact that nearly half of all the leaders in American industry today have had an engineering education." With unprecedented opportunities awaiting all engineer graduates, Col. Carey said that "with this field immeasurably widened by the miracle of nuclear fission, the young engineer willing to work and study in any branch of his profession has opportunity unlimited."

Col. Carey, who served in combat units in both World Wars and later was Chief Engineer of the Federal Works Agency, has been responsible for many important engineering projects, including public works, streets, highways, airports, water supply, river and harbor works and sewage systems. He served as a Director of the American Society of Civil Engineers for a district embracing Minnesota, Wisconsin, Michigan, the Dakotas, Montana and part of Canada. He has represented the Society and the Engineers' Joint Council at many foreign conferences. He was co-author of *Military Roads in Forward Areas,* extensively used in World War II and in Korea as a military text and reference work.

## Letters from Leaders on Engineer Training

In the last issue of Midwest Engineer we published the first of about thirty letters received from leaders of Chicago-area firms concerning shortcomings noted in the engineers in their employ. Many of the letters also suggested what the engineers should do to correct their deficiencies.

Significantly, the engineer's technical training is generally considered adequate. In the broad area of Human Relations, however, engineers seem often to be "under achievers," according to the viewpoint of the industrial leaders as reflected in their letters.

We are printing another of these letters in this issue, as we shall do in future issues. Although the letters may be of greatest value to the younger engineers, we hope that all of the engineers who read them will benefit.

Here, then, is the next letter:

Dear Mr. Becker:

This will acknowledge your letters of

*(Continued on Page 23)*

## Letters

*(Continued from Page 21)*

August 31 addressed to Messrs. ...... and ........ asking for comments on the educational program of Western Society of Engineers.

It is of course to be expected that the management of your Society would adequately visualize and meet the supplemental technical educational needs of your members.

You will probably find a unanimity of opinion among business leaders that it is also highly desirable for any supplemental educational program in the professional field to emphasize general management programs. This is particularly true among the younger engineers. The forum for young engineers which you conducted is a good illustration of the type of program which would be helpful in this respect.

An example of the over-all managerial problems to which the engineer might address himself is that of acquiring a more thorough understanding of the general economics of the particular industry or firm with which he has cast his lot. In any actual business problem, the conclusions and recommendations which might originally result from a purely technical survey or study must very frequently be modified, because of other business factors, to conform to the broader interests of the company. To acquaint engineers with the many elements affecting decisions on engineering proposals and plans is too often a disheartening task, and a program under your auspices designed to accomplish this would no doubt be of great service to general business management the country over.

## *Stockholders Okeh Merger of Utilities*

Merger of Public Service Company of Northern Illinois into Commonwealth Edison Company was approved by stockholders of both companies at special meetings on March 17. At the Edison meeting, stockholder representation in person or by proxy of more than 87% was the largest in over 25 years.

Edison stockholders elected thirteen Public Service directors to the Edison board. They are:

Preston A. Boyd, Freeport; Harry E. Burkholder, Sterling; James D. Cunningham, Chicago; Albert B. Dick, Jr., Chicago; Bernard E. Giertz, Elgin; Walter I. Jones, Joliet; William J. Kelly, Chicago; Joseph H. King, Chicago; Raymond F. List, Belvidere; Perry L. McPheeters, Wheaton; Leroy S. Stephens, Aurora; Edward Vaile, Dixon; and John Wentworth, Chicago.

Public Service, formerly a subsidiary, now becomes a division of Edison. The merger involves no changes in personnel or operations.

Willis Gale, Edison chairman, said the merger is the final step in a program of corporate simplification and integration which has been going on for 15 years.

As of December 31 last, Edison owned 2,157,233 shares, or 99.87 per cent, of the 2,160,000 shares of Public Service outstanding. The remaining 2,767 shares in the hands of the public will be converted on the basis of 4.2 shares of Edison stock for each share of Public Service stock, resulting in a nominal increase of 11,621 shares, or less than 1/10 of 1 per cent, in the outstanding Edison stock.

## Science, Technology, Benefits to Society

Science and Technology are having profoundly beneficial effects on our society, Dr. John T. Rettaliata, president of Illinois Institute of Technology, said in Chicago on March 23.

Dr. Rettaliata spoke before the Sigma Xi Society of Abbott Laboratories, North Chicago, Ill. The young college president is himself an engineer and a nationally-known authority on jet propulsion.

"It is my belief that science is providing us with the means to attain many of the age-old goals of the idealists," Dr. Rettaliata said, "and that it is laying the foundation upon which we can ultimately build the moral and spiritual order that the heart and soul of man have always craved."

Dr. Rettaliata condemned the belief that science contributes little to the nonmaterial advance of civilization. He characterized that belief as the heart of the challenge to science.

"By bringing the good things of life to the great bulk of the population, science and technology have done more to obliterate class distinctions than have all the labors of the world's utopian and socialist dreamers," he said.

Science is creating a new economic order in America, Dr. Rettaliata continued. The productivity of the machine is augmenting the saving and investing power of our people, he said, causing ownership to be widely distributed.

"The fundamental forces of science and technology are thus creating something of revolutionary consequence for the future: popular capitalism."

# Reviews of Technical Books

## Manufacturing

*Manufacturing Methods*, by Gilbert S. Schaller, McGraw-Hill Book Company, New York 36, N. Y. 1953. 613 pages. $7.00.

This book has been tailored to fit academic as well as industrial needs. The author's experience in industry has helped him in no small measure to present the material in the book in such a manner as to enable the student and general reader to have insight into the potentialities of the numerous engineering manufacturing methods surveyed in the book.

The chapters dealing with the light metals contain much informative material and illustration which is gratifying, since the importance of these materials in manufacture has grown rapidly in recent years. Emphasis is also laid on various foundry subjects, welding techniques and development of new machinery methods used widely in metal cutting fields.

Survey questions at the end of each chapter are a great aid to the student to learn and understand the most salient points contained in the chapter. References following each chapter should assist the interested reader to follow an advanced study of numerous manufacturing methods which develop at an accelerated rate in this modern world of production.

S.E.R.

## Route Location

*Route Location and Surveying*, by T. F. Hickerson, McGraw-Hill Book Company, New York 36, N. Y. Third Edition, 1953. 543 pages. $6.00.

In spite of its title, this is actually a new edition of an old book known to the profession under the title *Highway Surveying and Planning*. As the change in the title would suggest, the scope of the book has been broadened by the inclusion of such topics as railways, canals, pipe lines, etc.

With these exceptions, the outline and contents of this new volume follow closely those customary in textbooks on route surveying. After a general discussion of various transportation systems in Chapter I, the second chapter takes up the sequence and technique of route surveys, with horizontal and vertical curves, including spirals, covered in the next three chapters. Three more chapters are devoted to details of road surveying, such as superelevations, widening of roads, and an analysis of sight distances.

Chapter IX covers earthwork problems from the setting of slope stakes to the construction of the mass diagram. Drainage and construction questions are discussed in the next two chapters, while Chapters XII and XIII deal with problems peculiar to railroad layout. Miscellaneous topics of both technique and economy are finally included in the last chapter, followed by a substantial list of tables needed in the computation of curves, volumes, etc.

With its extended coverage, this new edition is likely to enhance further the popularity which this standard textbook has been enjoying for many years.

E.F.M.

## Hydraulics

*Introduction to Hydraulics and Fluid Mechanics*, by Jacob O. Jones, Harper & Brothers Publishers, New York, N. Y. First edition, 1953. 403 pages. Price $6.00.

This text is another which covers the conventional material on Hydraulics and Fluid Mechanics. The author presents a treatment of Hydrostatics followed by an introduction to Bernoulli's Equation and Similitude. Chapters on Flow Through Pipes, Pipe Computations, Flow in Open Channels, The Dynamics of Streams, Centrifugal Pumps, Turbines, the Measurement of Rate Flow and Compressible Flow round out the subject matter.

An attempt has been made to simplify the treatment so that the entire content of the book can be covered in one semester. Numerous problems and applications are presented.

A treatment of the Solution of Numerical Algebraic Equations by Successive Approximations is presented in the appendix.

J.G.D., W.S.E.

## Construction Costs

*Estimating Construction Costs* by R. L. Peurifoy, McGraw-Hill Book Company, New York 18, N. Y. First edition, 1953. 315 pages. $5.50.

This volume is suitable for either reference or teaching purposes. Subject headings include Material Handling, Earthwork, Highways, Foundations, Concrete Structures, Floor Systems, Masonry, Timber Structures, and Water and Sewerage Systems. The scope of the material presented has been made broader than that in previous texts in the field by discussing new building construction methods such as tilt-up construction and slip forming, steel fabrication and erection, and public works projects including highways, sewers, and water mains.

There are numerous problems and illustrative examples distributed throughout the book. Supplementary information of use in making estimates is presented in the Appendix. The major criticism of this, and other similar texts, is that the cost information presented is soon out-of-date.

J.G.D., W.S.E.

# First U. S. Turbine Transport Indicates Air Cargo Increase

America's first turbine-powered transport points the way toward greatly increased movement of cargo and passengers by air with substantial savings in time and money, a luncheon meeting of the American Power Conference was told in Chicago on March 27 by E. B. Newill, Vice President of General Motors and General Manager of the Allison Division.

Describing a routine flight from Indianapolis to Chicago in the Allison Turbo-Liner, Mr. Newill said the trip represented a reduction of 16 percent in travel time and savings in fuel cost of more than 25 percent, compared with today's commercial airliners.

The Turbo-Liner is a standard two-engine Convair passenger transport, purchased by Allison and modified for two Allison turbo-prop engines. A turbo-prop is like a jet engine except that it derives its power from a turbine-driven propeller rather than from jet thrust.

Pointing out the differences in turbine-powered flight, from the passenger viewpoint, Mr. Newill said the take-off is smoother with less noise and vibration; that climb to cruising altitude is faster by 75 percent and that in level flight, speed is increased 56 miles an hour over a similar aircraft equipped with today's piston-type engines.

"Turbo-prop aircraft will make a definite contribution toward relieving airport noise problems," he pointed out. "After taxiing to the end of the runway with our engines running at 75 percent of their takeoff speed, we took our turn for takeoff behind one of our fastest commercial air transports and an executive type plane.

"After the other planes had taken several minutes to run up each of their engines to full power before takeoff, we prepared for our takeoff. For us it consisted only of a switch to full 14,300 RPM speed for both engines, a check of instruments by the pilot, and within 30 seconds after go-ahead from the tower, we were moving down the runway.

"We used less than 2000 feet of runway and our rate of climb was 2500 feet per minute at 200 miles an hour. We were pushed firmly back in our seat but there was lack of vibration and an immediate decrease in noise level. Ground observers say noise on the ground drops immediately and they liken the effect to that of a 'purr'."

"Almost immediately, we overtook and passed the airliner by a good speed margin, even though we were still climbing at 1100 feet per minute. At 6000 feet we cruised at 300 miles an hour with the engines running smoothly at 80 percent power.

"About 30 minutes after takeoff, we were in sight of Midway Airport in Chicago. A wide sweep was made around the airport and just 38.5 minutes after starting our takeoff in Indianapolis we were on the ground in Chicago. While workmen at the airport stopped to watch with much interest, our pilot in the Turbo-Liner brought his engine-propeller control to minimum power position. The negative thrust of the propeller, without any change in engine speed, brought the airplane to a stop within 2000 ft. without the pilot ever touching the brakes.

"In addition to the 16 percent reduction in the standard time of 46 minutes for this short trip, we calculated our saving in fuel cost at from 50 to 65 percent of standard. This arises from the fact that a turbine engine uses kerosene type fuel which costs 35 to 50 percent less than high octane gasoline."

Mr. Newill said the turbo-prop engines in the Turbo-Liner are Allison T38's which were developed under sponsorship of the U. S. Navy. Each of the two engines develops more than 2750 horsepower which is equivalent to two horsepower per pound of weight compared with a one-to-one ratio for the 2400 horsepower piston engines in the standard Convair Liner. Four-bladed, fully reversible Aeroproducts propellers are used on the Turbo-Liner.

"The Turbo-Liner is our privately financed venture which will enable us to gain experience in turbo-prop installations, which will be of great importance also to the military services and builders and operators of commercial aircraft," Mr. Newill emphasized.

"To date we have carried more than 800 military passengers to demonstrate the characteristics of turbine flight. Total flights to date number more than 225, with more than 200 hours flying time. In one 2½ day period, we made 27 flights, every hour on the hour, and never were we more than 10 minutes off schedule. To us this means that the Turbo-Liner is a dependable and practical aircraft, and, as this trip indicates, we are now using it for casual transportation of our people.

"We believe that before long gas turbine engines will replace piston type engines in all large aircraft. For very high speed military aircraft and for premium high speed passenger travel, turbo-jet engines will get the call. However, there is a very large military and commercial requirement for aircraft with speeds up to 500 miles an hour for short or very long range missions.

"Turbo-prop engines, with the great cost savings that are inherent in them, will dominate this field. An outstanding example of this type of aircraft is the newly-announced Lockheed C-130 transport and cargo airplane, powered with Allison turbo-prop engines. This is the first U. S. aircraft designed from the very beginning for turbo-prop power.

"It will have the ability to carry large tonnages higher and faster than any aircraft so far built. With turbo-prop power, it may be the forerunner of a wholly new concept in aircraft design, for economical turbine-powered transportation applying both to military and commercial air operations."

## AIEE Group to Meet

The committee on Electric Heating and the Michigan section of the American Institute of Electrical Engineers is sponsoring a conference on electric heating, in cooperation with the Industrial Electrical Engineers Society of Detroit, on May 26 and 27.

The two days of meetings will be devoted to discussions of many industrial uses of electricity.

Further information concerning the conference and programs may be obtained from Harold Bunte, Commonwealth Edison Company, 72 West Adams street, Chicago 90. His telephone number is RAndolph 6-1200, Extension 3398.

## WSE Personals

**Henry T. Heald,** Past President of the Western Society, and Chancellor of New York University, has been elected to the Board of Directors of the Equitable Life Insurance Society.

**Dr. Eugene Mittelmann** has been re-elected Chairman of the Professional Group on Industrial Electronics of the Institute of Radio Engineers.

**James L. Foley, Jr.,** is now with J. E. Greiner Company, Consulting Engineers, 1106 N. Charles Street, Baltimore, Md. He was formerly Traffic Engineer, Bureau of Street Traffic, City of Chicago.

**Francis A. Cox** is now System Distribution Engineer, Commonwealth Edison Company. Formerly he was Assistant to Electrical Engineer, Public Service Company of Northern Illinois.

The office of **J. J. Scheerens** of the Insulux Division of Kimble Glass Company is now located in Room 2810, Civic Opera Building, 20 N. Wacker Drive. The telephone is STate 2-6090. The former address was 221 N. LaSalle Street, Chicago.

**Herman M. Ross** is now with Economy Lamp Works. Previously he had been District Manager, Graver Water Conditioning Company.

**Frank J. Hradecky** is now Open Hearth Engineer with Freyn Engineer Department of Koppers Company, in Chicago. Before taking this position he had been Furnace Design Engineer.

**Robert K. Matthews** is Assistant General Superintendent of Construction with Koppers Company, Inc., in Pittsburgh, Pa.

**Bill Clynes,** son of **Mr. and Mrs. Dennis J. Clynes,** recently married the former **Lois Lindquist** of Brainerd, Minn.

In 1947 and 1948, Bill commanded a combat engineer unit. After his discharge from the army in 1948, he entered Purdue, from which he was graduated on January 4 of this year.

Bill and his bride spent their honeymoon in the south.

**E. N. McDonnell,** President, McDonnell and Miller, Inc., was awarded the 1952 F. Paul Anderson Medal of the American Society of Heating and Ventilating Engineers.

**Dr. Gustav Egloff** of Universal Oil Products Company has been elected an honorary member of the Association Francaise des Techniciens du Petrole, Paris, France.

**R. J. Pigott,** Past President and fellow of A.S.M.E., consultant for the Gulf Research Development Company, was elected President of the Engineers Joint Council. **T. A. Marshall, Jr.,** was appointed Secretary of the Council.

**W. A. Kuechenberg,** president of R. B. Hayward Co., Chicago sheet metal contracting firm, was recently given an award by the Illinois Chapter, American Society of Heating and Ventilating Engineers in appreciation for his services as chairman of the committee on arrangements for the 55th and 59th national meetings of the ASHVE, held in Chicago during 1949 and 1953. Presentation of a pen and pencil desk set was made by Chapter President, M. W. Bishop, at the Chapter's March meeting.

**Dr. J. Henry Rushton,** an authority on the chemical engineering aspects of mixing, was named last December the 17th recipient of the coveted Walker Award for outstanding achievement in his field. He is director of the department of chemical engineering at I.I.T.

In presenting the annual award, W. I. Burt, president of the American Institute of Chemical Engineers, told Dr. Rushton that he was chosen for the honor "in recognition of his excellent publications dealing with mechanical mixing, equipment design, and engineering education."

Dr. Rushton has a distinguished background in teaching, national defense work, consulting, research, and industry.

He is the author of more than 40 technical articles on the engineering aspects of mixing, many of which pioneered new concepts. He also, is co-author of a textbook, *Process Equipment Design,* with Herman C. Reese, and has written chapters for several other books.

After serving as chairman of the department of chemical engineering at the University of Virginia for nine years, he came to Illinois Tech as director of the department in 1946. He also has taught at the University of Michigan and Drexel Institute of Technology. From 1943 to 1946, he was director of the Thermodynamics research laboratory at the University of Pennsylvania and has since served as its technical advisor.

Portable oxygen units for the Air Force and Navy, and field-type oxygen plants for submarine and projectile uses were the result of his work as chief of the Oxygen Section for the Office of Scientific Research and Development during World War II. In this capacity he coordinated research in a number of university and industrial laboratories, and he has continued his association with OSRD as an expert consultant.

**Charles W. Walker** is the General Construction Superintendent at Illinois Bell Telephone Company, and heads the Construction Division of the company.

In the March, 1953 issue of this magazine, we erroneously reported that Mr. Walker was Area Construction Superintendent at the company. That was the position he held prior to his present one of General Construction Superintendent.

# Spectacular Salary Advantages Enjoyed Today by Engineers

American industry now hires one engineer to approximately every 60 production workers. The number of chemists is doubling every 15 years, of physicists every eight years. This increased demand translates itself into spectacular salary advantages for engineers. The average engineer receives a beginning salary of $334 and rates are still changing upward. The problem of the recruiter and trainer is, in addition to persuading the few obviously capable people to come with his company, to keenly appraise those available to him and, perhaps, select someone whom other recruiters might reject. Then, with skillful and patient training, bring that man to a point of high usefulness. This was brought out in an address by John Gammell, supervisor of sales training, Allis-Chalmers Manufacturing Company, before the First Annual Management Division Conference of the American Society of Mechanical Engineers in Detroit on April 16.

Selection methods of the recruiter and industrial trainer must be geared to the new condition. His training and placement methods have to be better in order to more effectively use people whose talents are less obvious than those he has dealt with in the past.

I have found that three simple checks will put the recruiter a long way along the road of deciding whether a potential employe is acceptable. I look at a man's grades, and his activities—not always easy to weigh, and I try to analyze his personality. This is most difficult. For instance, after a good lunch the personalities will look better than just before lunch.

There are numerous minor tricks which we use to probe into details which might appear interesting to us. If a prospect's family was well educated but the man's grades seem low, I would tend to discount it unless I found some serious defect. If a man did not seem too personable but his father was a minister and he was satisfactory with regards to grades, activities, and appearance, I would certainly take him on the basis that he must have had much social experience. His personality would probably blossom well when needed.

Selection methods with regard to details are best left to the individual recruiter's ideas. It is just as well that they do have differences, particularly in large companies where different types of men are needed.

**Training**

After these men are in our plant, we come to the problem of training and placing them in the job where they can do the most good for themselves and the company.

As to their status when we get them, one of the most persistent complaints about engineers, heard from the layman, is that he is an uninteresting fellow who does not write very well and talks worse. In order to overcome their awkwardness in writing and speech, it would seem most essential that any training put particular emphasis on these two points.

Another necessity for good training of engineers is to somehow inculcate in them the fact that commercial necessities and economics are important components of what they do. I like to point out that the ancient Egyptians knew something about the power of steam. A good commercial man would have, perhaps, developed this "know-how" toward pumping up water out of the Nile or for some other useful purpose rather than that of opening and closing temple doors for the mystification of the populace.

It is necessary in industry for a student to learn how to work. Up to this time he has lived in a world where he has been the center of attention, the reason for his family's existence, the reason for his school's existence and the focus of its purpose. Now he comes into industry where he is on the outside of the circle and has to fight his way in. Most industries comprise, essentially, a group of people who are struggling hard to make a good living for themselves by their collective efforts and they do not readily accept an outsider unless he can help them to improve their lot.

In school there is a definiteness about a student's activities. When he takes a job in industry on a professional level, however, he does not know whether the problems he has each day will be in the field of human relations, mathematics, or something else.

# *Atomic Energy Men Hold Energy Forum*

A group of atomic-energy experts from government and business took part in a forum on "The Industrial Use of Atomic Energy" at the American Power Conference in Chicago on March 25-27 in the Hotel Sherman.

The atomic-energy forum was one of the highlights of the 15th annual Power Conference sponsored by Illinois Institute of Technology.

Among the forum speakers were W. L. Davidson, director of the office of industrial development, Atomic Energy Commission, Washington, D. C.; Walter H. Zinn, director of the Argonne National Laboratory, Chicago; Rep. Carl Hinshaw (R-Calif.), chairman of the reactor subcommittee, Joint Congressional Committee on Atomic Energy; and Walker L. Cisler, president of the Detroit Edison Company, Detroit.

The speakers explored the engineering, economic and governmental aspects of the industrial use of atomic energy.

Fred G. Aandahl, Assistant Secretary of the Interior, addressed the All Engineers Dinner at the Conference on March 26. Aandahl is former governor of North Dakota. Dr. John T. Rettaliata, President of Illinois Tech, presided at the dinner.

The American Power Conference opened at 9 a.m. Wednesday with an invocation by His Eminence, Samuel Cardinal Stritch, archbishop of Chicago. The welcoming address was given by Charles Y. Freeman, Chairman of the executive committee, Commonwealth Edison Company.

Following Freeman, Dr. W. A. Lewis, Dean of the I.I.T. graduate school, explained the aims and purposes of the Conference. Main address at the opening session was by W. A. Roberts, President of Allis-Chalmers Manufacturing Company, Milwaukee.

During the three days of the Conference, 90 papers and talks were presented by prominent executives, engineers, and scientists. The 36 sessions were devoted to a wide variety of subjects, including residential heating and air conditioning, gas turbines, solid and liquid fuels, and hydroelectric power on the Niagara and St. Lawrence rivers.

# Make Headquarters

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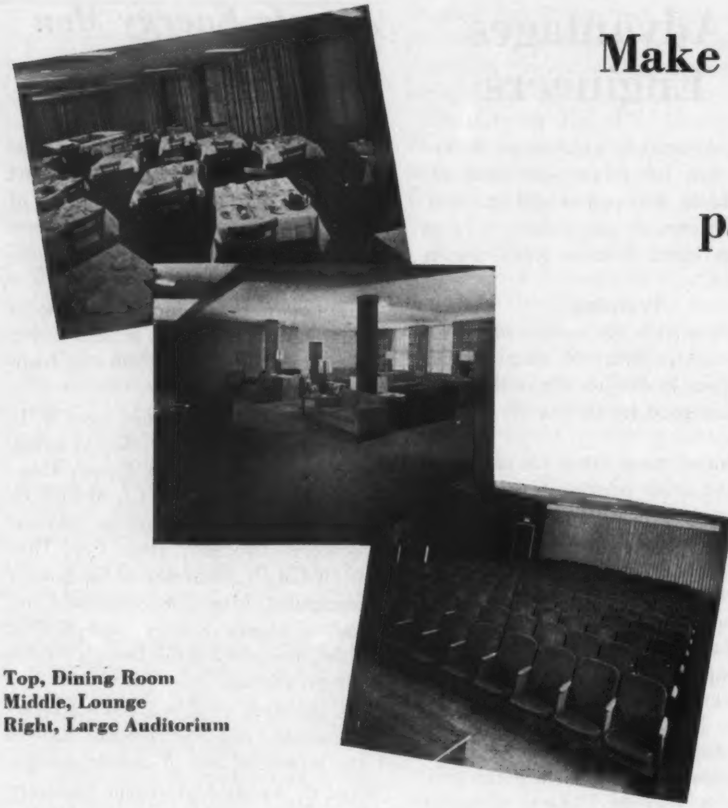

**Top, Dining Room**
**Middle, Lounge**
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- ***Relax in the lounge***
- ***Meet your friends***
- ***Lunch leisurely***
- ***Dine with the family***
- ***Use the lounge and dining room for your parties***
- ***Luncheon- 11:30 a.m. - 2 p.m.***
- ***Dinner- 5:30 p.m. - 8 p.m.***

Monday night meetings are planned specifically for the members' interest. They keep members up-to-date with the improvements and discoveries in their fields. Wednesday noon luncheons are held each Wednesday from 12:15 to 1:30 p.m. Members and guests receive an excellent meal, hear a stimulating speaker, and join in good fellowship. For reservations call RA 6-1736.

# Headquarters of The Western Society of Engineers

## National Electronics Names J. D. Ryder as its 1953 President

Dr. J. D. Ryder, head of the electrical engineering department, University of Illinois, Urbana has been named president of the 1953 National Electronics Conference Inc. Dr. C. E. Barthel, Jr., Illinois Institute of Technology, Chicago was named chairman of the board.

The ninth annual conference will be held September 28, 29 and 30, 1953 at the Hotel Sherman in Chicago.

Registration at the 1952 conference totaled 6,165. Ninety seven papers covering a broad field of electronic research, development and practical application were presented. The technical program was supplemented by 120 booths of exhibits by manufacturers foremost in the electronics field.

Other Officers are: Executive Vice President, R. M. Soria, American Phenolic Corp., Cicero, Illinois; Executive Secretary, Karl Kramer, Jensen Radio Co., Chicago, Illinois; Secretary, J. M. Cage, Purdue University, Lafayette, Indiana; Treasurer, G. E. Foster, Metrotype Corp., Chicago, Illinois; Arrangements Committee Chairman, J. S. Powers, DeVry Corp., Chicago, Illinois; Proceedings Committee Chairman, E. A. Roberts, Illinois Institute of Technology, Chicago, Illinois; Exhibits Committee Chairman, O. I. Thompson, DeForest's Training, Inc., Chicago, Illinois; Program Committee Chairman, W. L. Emery, University of Illinois, Urbana, Illinois; Procedures Committee Chairman, LeRoy Clardy, Swift and Co., Chicago, Illinois; Publicity Committee Chairman, S. R. Collis, Illinois Bell Telephone Co., Chicago, Illinois; Housing Committee Chairman, E. H. Finch, Sargent and Lundy, Chicago, Illinois.

## *Management Course Offered at Iowa State*

The College of Engineering, State University of Iowa, announces the fourteenth Summer Management Course to be held June 15 through June 27, 1953 in Iowa City.

Since its inception, over 1000 representatives of American and foreign business, industrial, and governmental organizations have increased their understanding of the design and application of the major management techniques.

It is an intensive course for factory managers, foremen, industrial engineers, methods and time-study analysts, cost accountants and office executives.

The areas of Production Planning, Job Evaluation, Motion and Time Study, Wage Incentives, Plant Layout, Materials Handling, Quality Control, Supervisory Training, Labor Relations and Legislation, Organization and Policy, and Public Speaking are included.

The regular State University of Iowa teaching staff will be augmented by outstanding men from a variety of industries and other educational institutions.

Communications concerning the course should be sent to Wayne Deegan, 113 Engineering Building, State University of Iowa, Iowa City, Iowa.

# Makers of Vehicles for the U. S. Military Return to Wood Use

The return of wood to military vehicle construction, as an important step by the lumber industry in the defense program, was given impetus in Washington, March 9, when the industry presented three modern, all-wood Army truck bodies to the Ordnance Corps in a brief ceremony at The Pentagon. High government and military interest was indicated by the official representation that overflowed the meeting room.

The truck bodies, each of a different type and embodying the latest developments in wood technology, were designed and built at the laboratory of Timber Engineering Company, research affiliate of National Lumber Manufacturers Association, in cooperation with officials of the Ordnance Corps and the Corps of Engineers.

Completion of the prototype bodies culminates five years of intensive industrial research conducted at the Teco laboratory by the lumber industry in solving problems presented by the building of 1,000,000 wood bodies in World War II.

Carl A. Rishell, Teco's director of research, discussed the design and construction of the truck bodies as a product of industrial research for national preparedness. Among the innovations in this new system of construction are new waterproof glues; new treating materials and processes; the art of gluing treated wood; use of modern water repellants, and modern concepts in designing laminated assemblies. After describing these technical developments that made the new bodies radical departures from the traditional idea of truck body construction, he formally presented them to the Ordnance Corps.

Col. J. A. Barclay, executive officer, Research and Development Division of Ordnance, accepted the truck bodies on behalf of Maj. Gen. E. L. Ford, Chief of Ordnance.

Col. Barclay commended the lumber industry for its efforts on behalf of national preparedness, and assured its representatives that the truck bodies would be given thorough road tests at the Army's Aberdeen, Md., Proving Grounds. He pointed out that, in discharging its duties of providing the needs and desires of "the men in the field," the Ordnance Corps "has grown to depend more and more on industrial research."

Gen. J. A. Cranston, Ret., director of special activities, National Security Industrial Association, presided. Following the presentation ceremonies, the group viewed the truck bodies that were on display in The Pentagon's inner court.

Members of Congress attending the meeting included Senator John L. McClellan of Arkansas, and Representatives Harris Ellsworth (Oregon), Oakley Hunter (California), Russell V. Mack (Washington), and John Westland (Washington).

## Engineering Societies Personnel Service, Inc.

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### OVER THE MANAGER'S DESK

April brings forth the buds of Spring which will blossom out later into the beauties of nature. It can also be the month of budding ideas which may blossom into new engineering achievements, new progress, and new profits.

Take advantage of the budding spirit of the month and let us find that new employee for you or that new position which will help you blossom out with new achievements, progress, or profits for you as an employer or employee.

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### POSITIONS AVAILABLE

R-9765(b) LAND SURVEYOR. Registered preferably with 10 years exp. in Chicago and suburb. Salary: open. Location: Chicago.

T-9765(c) RESIDENT ENGINEERS (3 or 4) preferably grad. civil engineers. Must be thoroughly reliable and competent to supervise construction of buildings, hospitals, sewage treatment plants, water filtration plants, sewer construcion, paving work, etc. Salary: to $550. Loc.: Middlewest.

R-9764(a) DRAFTSMAN. 2 plus years exp. in plant layout and preferably foundries. Knowl.: foundry equipment. Duties: make sales drawings in estimating department. For an engineering firm. Salary: $2 to $2.25 per hour. Employer will pay fee. Location: Chicago.

R-9764(b) ESTIMATOR. 2 plus years exp. in estimating work on foundry equipment or heavy machinery. Knowledge of foundry equipment desirable. Duties: estimating and pricing foundry equipment, installation and other kindred activities. Salary: $2 to $2.25 per hour. Employer will pay fee. Location: Chicago.

T-9763 DEVELOPMENT ENG. 5 plus years exp. in developing vending or coin machines. Know: Model constr. Duties: developing, designing and testing new items in the vending machine field. For a Mfr. of Vending Machines. Salary: $7500-$10,000. Location: Illinois. Employer will pay the fee.

R-9762 EL. FOREMAN. Age: 35. 3 plus years exp. as industrial electrical foreman. Know: of maintenance and construction. Duties: Supervise electrical maintenance and constr. crew for industrial plant. Sal.: $500-550 mo. Location: Chicago. Employer will pay fee.

R-9760(c) ELECTRONIC DRAFTSMAN. 1 plus years exp. in drawing schematic and pictorial diagrams for electronic circuits. Knowledge of chassis wiring. Duties: drawing schematic and pictorial electronic wiring diagrams. Some background in plain mechanical drawing will be usable. For a manufacturer of office equipment. Employer will pay fee. Location: Chicago. Salary: $75 to $90 per week.

R-9760(d) MICROWAVE DEVELOPMENT ENGINEER. E.E. 5 plus years exp. in design or development of antenna systems. Duties: develop antenna systems from 1 to 10 cc region. For a manufacturer of office equipment. Salary: $7000-7500 per year. Employer will pay fee. Location: N.W. Chgo. Suburb.

R-9759 CHEMICAL ENGINEER. Grad. Age: to 35. 5 years exp. in plant and dev. work in chemical industry. Knowledge of electrical welding. Duties: plant maintenance and chemical development work for manufacturer of chlorides. Salary: $4800 per yr. Location: Chicago. Employer will negotiate fee.

R-9758 DESIGNER. 5 years exp. on roller die work. Duties: designer of roller dies must be good on mathematics. Salary: to $150 per week. Location: Chicago.

T-9757 SANITARY AND STRUCTURAL ENGR. B.S. in Eng. Age: 35-50. At least 10 years exp. sewer systems, sewage treatment, water supply treatment, distribution, personnel supervisory exp. Must be licensed struct. engr. in State of Ill. Actual duties: be in complete charge of sanitary dept. Salary: $10,000-$15,000. Location: Illinois.

*If placed in a position as a result of an Engineers Available or Position Available advertisement, applicants agree to pay the established placement fee. These rates are available on request and are sufficient to maintain an effective non-profit personnel service. A weekly bulletin of positions open is available to subscribers. Apply ESPS Chicago.*

### ENGINEERS AVAILABLE

TIME STUDY ENGR. 32. Six yrs. 6 mos. Industrial Eng. doing time study, wage incentives, methods, plant layout, job evaluation and personnel. $7000 Midwest 588 MW.

CONSTR. SUPT. CE 26. Eleven mos. Gen'l. Engr. doing field to office liaison work. Two yrs. Constr. Engr. doing inspection of a central heating and power plant and a Dam. $5200 Chicago 589 MW.

CONSTR. SUPT. CE 25. Twenty-one mos. Constr. Engr. doing specs., estimates, material control and approval. $5400 U.S. 590 MW.

FIELD ENGR. Arch. Engrg. 33. Three yrs. Engr. doing estimating, layout duct work, drafting, surveying, cost engrg., field engrg., structural design. $5720 Chicago 591 MW.

CHEMICAL ENGR. Chem. Engr. 35. Eight yrs. Technical adviser and investigator of processing difficulties. Nine yrs. Develop processes for the extraction of pharmaceutical products from animal glands. $7000 Chicago 592 MW.

SALES ENGR. ME 24. Eighteen mos. field engr. inspecting and expediting fabricated steel. One yr. doing design of small structures in plant expansion program. $5200 U. S. 593 MW.

SALES ENGR. Met. Eng. 29. One year serve as trouble shooter and aluminum technical adviser to sales force. Two yrs. quality control in open hearth, rolling mills and metallurgical lab. $6500 Chicago 594 MW.

FIELD ENGR. CE 33. One yr. advise customers on economical use of aluminum. Six yrs. project engineer directing activities on research project $7800 Chicago 595 MW.

SALES ENGR. ME 29. Four yrs. calling on industry in Chicago area to prescribe for lubrication needs in machinery and equipment. $7200 U. S. 596 MW.

SALES ENGR. ME 28. Three yrs. Sales Mgr. in setting up new company and sold direct to customer gasoline, diesel engines and generating sets. $6000 Midwest 598 MW.

# Meeting to be Held by Military Engineers

Colonel Bernt Balchen, Olympic boxer, skier, flier and polar explorer, and now Special Assistant to the Director of Installations, United States Air Force, will be the speaker on Friday, May 15 at 12 o'clock noon, before The Society of American Military Engineers.

WSE members are cordially invited to attend this interesting meeting. However, attendance is by reservation only, and the dining room will be closed on this one day, except to persons with reservations. Other members of WSE will be served in the small auditorium.

The price for this May 15 luncheon-meeting will be $2.25.

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